JPRS-EST-93-011
12 March 1993

JPRS Report

Science & Technology

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Science & Technology
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Germany: Research in Diamond Vapor Deposition

93WS0145A Stuttgart BILD DER WISSENSCHAFT in German Dec 92 pp 14-18

[Article by Wolfgang Asche and Rolf Froboese under the rubric "Technology": "Brilliant Career. Artificial Diamonds Increase Research on Materials"; first paragraph is an introduction]

[Excerpts] Diamond fever has broken out in research laboratories around the globe. For very thin diamond films can make drills harder, chips faster and automobile engines less polluting.

[passage omitted] A team of scientists at Moscow University headed by Professor Dmitriy Fedosev did trailblazing work on the low-pressure synthesis of diamonds as far back as the end of the seventies. But the pioneering feat was taken note of for the moment only by Japanese research teams, who quickly modified the process and protected it with a rampart of 500 patents.

The Japanese already had a substantial technical lead when the diamond fever then took hold of the U.S. "The West's technology arrogance prevented the Russian work from being taken seriously," Ralph-Juergen Peters of the VDI [Association of German Engineers] Technology Center in Duesseldorf criticized. Peters is the coordinator of the diamond synthesis research program subsidized by the Federal Ministry for Research and Technology (BMFT).

[passage omitted] In the international competition for the precious upper layer it is a question not only of purity but also of speed. The Battelle Institute in Geneva, almost at the same time as a study group at Pennsylvania State University, has been able to speed up the deposition rate from 0.002 to 0.1 millimeter per second by means of a newly developed "jet plasma technology." The Battelle Institute in Frankfurt is also taking part in the international competition for the most serviceable thin-film diamonds. A process was developed there by which so-called diamond-like carbon films can be deposited even at room temperature. These deposits consist of a slightly hydrogenous carbon that is present in part in a diamond modification. Yet the films resulting from this prove to be extremely resistant to attack by chemical action.

[passage omitted] Several companies and researchers have been seized by the diamond frenzy in Germany too. For instance, Guehring, the small- to medium-sized toolmaker in Albstadt in Swabia in the fall of 1990 brought onto the market for the first time ultrahard drills. Together with CemeCoat, a coating specialist domiciled in Aachen, it succeeded in coating hard-metal drill twists "round and round the corners too," according to development head Jan Ebberink. Minister Riesenhuber was also generous in view of the brilliant prospects. Both companies are to push on with their basic research in a three-year joint project with a BMFT subsidy of just under 5 million German marks [DM]. [passage omitted]

German Researchers Demand New Biotechnology Law

93WS0145B Stuttgart BILD DER WISSENSCHAFT in German Dec 92 pp 30-33

[Article by Reiner Korbmann under the rubric "Genetic Engineering": "In the Shackles of the Law. Researchers Demanding a Better Genetic Engineering Law"; first paragraph is a synopsis]

[Excerpts] The law was hurriedly stitched together and accordingly turned out slipshod. A BILD DER WISSENSCHAFT opinion poll of leading researchers shows the weak points.

The Constitution of the Federal Republic of Germany leaves no room for doubt: "Research and teaching are unrestricted." This is the basis for successful research. However, whoever visits research laboratories between Kiel and Konstanz today is soon informed of the limits of freedom. This applies above all to a discipline that is becoming more and more the key to many technologies of the future: genetic engineering.

The statute book, ordinances and forms have become just as important as test tubes and Petri dishes in the genetic engineering laboratory. The German genetic engineering law, which every researcher has to comply with, has been in force here for two and a half years. It was to guarantee safety from the risks of genetically altered organisms. However, it seems after 30 months as though the only certainty it offers is the extinction of German genetic research.

This is the conclusion of a BILD DER WISSENSCHAFT opinion poll. A total of 73 leading researchers from industry, major research institutes, Max Planck institutes and universities were questioned about their experiences with the law and were to offer suggestions for improvement.

[passage omitted] The conclusion is a big slap in the face for the politicians: The genetic engineering law is inconsistent with its own goals, it is strangling research with bureaucratic baggage and in the long term it is preventing genetic engineering from being able to take place on an internationally comparable level in Germany.

"No problem will be solved; instead, new difficult problems will be caused by the genetic engineering law," is the criticism given by the head of Heidelberg University's Center for Molecular Biology, Professor Hermann Bujard. His colleague, Professor Guenter Haemmerling, president of the European Network of Immunology Institutes, is finding "that the German genetic engineering law is not only winning shakes of the head and encountering incomprehension abroad, but is also providing occasion for serious concern." One of the most

prominent German genetic researchers, Cologne biologist Professor Jozef Schell, sees in the law "a threat to the Federal Republic's research and commercial position in this field."

The scientists questioned by BILD DER WISSENSCHAFT see seven central problems. It is not even a question of the text of the law here. What the researchers criticize is the 28 additional implementing ordinances.

Problem One: Safety

Genetic engineering has not become safer through the law than it already was before. This is the argument of most of the researchers. However, many look at it differently. For instance, the head of Munich University's Genetic Engineering Center, Professor Ernst-Ludwig Winnacker, thinks that the commercial bases of the law are beginning to dwindle more and more. "It is becoming more and more clear that there is not a genetic engineering risk as such, but that the risk potential of a genetic engineering experiment depends only on the danger potential of the altered organism."

Some scientists, like the chairman of the biological safety committee at the Max Planck Institute for Biochemistry in Martinsried, Dr. Hans-G. Heidrich, welcome the legal certainty that the law has brought. "The public debate concerning genetic engineering has been brought from an emotional to a relatively objective level" through it.

Problem Two: the Research

All biological research in Germany threatens to lag behind because of the genetic engineering law. According to the replies, science is becoming a real hurdle race. Though approximately 80 percent of all genetic engineering experiments involve no risk in the opinion of the researchers, still they have to be applied for on extensive forms and approved in laborious procedures that take up to eight months. More and more German genetic engineering researchers are moving abroad, and foreign researchers can hardly be gotten any more.

Problem Three: the Dangers

What is so dangerous about genetic engineering? The law divides experiments into four levels of safety that range from "no risk" (S1 [Level 1]) to "high risk" (S4). Dr. Peter Stadler of the Bayer chemicals group calculated that around 3,000 pages of paper have to be submitted for the approval of a level-S1 experiment, for example. The cost of the application: between 50 and 150 hours and 15,000 to 45,000 German marks [DM]. Unanimous demand: easing of requirements for safety levels S1 and S2. At level S1, approval should even be replaced by simple registration.

Problem Four: the Training

If the implementing regulations of the genetic engineering law are in force for a long time yet, there is the danger that students will no longer get to learn genetic engineering. Even in traineeships at the lowest safety levels, thorough investigations are required before the work begins and blood samples have to be stored for 10 years. Because students study at large-scale universities today, the expense is easy to grasp.

Problem Five: the Industry

The genetic engineering law was actually to succeed in the industry's finding protected terms for research and production in Germany too. The fact is that the large German pharmaceutical companies have built large research centers, and to some extent even production sites, in the U.S. or Japan. Only conventional research remains in Germany.

Problem Six: Foreign Countries

Research is international, but genetic engineering researchers are still not even allowed to exchange specimens of individual altered organisms with their colleagues abroad. Because the genetic engineering law prohibits the import or export of organisms from/to laboratories that do not come under the law. German researchers threaten to become isolated even within the European Community.

Problem Seven: the Inspectors

The regional authorities, responsible for observance of the law, are in the opinion of many scientists overtaxed by the complicated subject matter. The provisions are interpreted defensively by the public officials. "Plain authority-violating arbitrariness," declares Professor Thomas Trautner of the Max Planck Institute for Molecular Genetics in Berlin.

And Konstanz biologist Dr. Rolf Knippers even sees in the inspection administration "a colossal job-providing measure for otherwise unemployed academics: A veritable molecular biology research institute could even have been set up with them."

The irritation of the persons affected has changed in part into weariness with politics: "The research will go on, within the framework of the law or even against the law, which, like much other rubbish that the politicians generate, cannot at all be taken seriously," cell biologist Professor Walter Nagl of Kaiserslautern University says in anger, and he calls into question the law's authority: "Every ruling in the purview of this law that was ever supposed to have been made 'in the name of the people' is to be classified from the outset as popular deception." However, it is not only the politicians that bear the blame. At the very beginning the genetic researchers alone tried to get a grip on the risks of their discipline.

They came out with a moratorium even before the first experiments. Their Asilomar, California, conference in 1974, where basic safety rules were adopted, became the milestone.

This was well meant. But the genetic engineers overlooked in this connection the fact that experts can indeed

decide how a risk can be reduced. But whether a risk is acceptable to society, society itself has to decide. But the politicians are included not until much later in arriving at a decision.

A decision of the Kassel Administrative Court in 1989 was an occasion for the politicians to hurriedly stitch together within a few months the German genetic engineering law, in spite of many impartial and political differences of opinion (see "The Conflict Around the Genetic Engineering Law," BILD DER WISSENSCHAFT, No 4, 1990). In view of the haste, no one could really hope that it would be long-lasting.

"German genetic engineering research will require a longer time span in order to make up for the retrogression of the last two years," Dr. Heidrich, in charge of safety at the Max Planck Institute for Biochemistry in Martinsried, believes. "One can realistically proceed on the assumption that, for the present, each lost year can be made up for again in at least double the time span."

A prerequisite for the success of reform is certainly also that the Federal Minister of Public Health is helped by good advisers and courageous public officials. However, personal courage appears to be a rarity in his purview.

One of the few genetics researchers that did not respond to BILD DER WISSENSCHAFT's questions was Professor Reinhard Kurth, president of the Paul Ehrlich Institute, which operates the most modern genetics laboratory in Germany in Frankfurt am Main (see "Germs in Quarantine," BILD DER WISSENSCHAFT, No 3, 1992).

"I very much welcome your opinion poll on the genetic engineering law, but on this occasion I would like to outwardly keep very much in the background, because the law comes from 'my' ministry. I am sure that you will get very clear answers from other colleagues, and I ask for your understanding that I prefer to adopt a 'low profile' in this matter."

We understand, and we hope the minister does too. [passage omitted]

German High Temperature Metal Alloy Research Noted

93WS0221A Frankfurt/Main FRANKFURTER ALLGEMEINE in German 13 Jan 93 p N2

[Article by Georg Frommeyer, staff member, Max Planck Institute for Iron and Steel Research, Duesseldorf, under the rubric "Nature and Science": "Materials for Extreme Stresses. Intermetallic Alloys Withstand High Temperatures, Are Lightweight and Corrosion-Resistant"]

[Text] Technology is imposing ever higher requirements on materials. For building jet engines and internal combustion engines researchers are looking for materials that withstand high temperatures, are lightweight and are resistant to oxidation. The goal is to raise substantially the thermal efficiency of prime movers. Major progress is to be expected from so-called intermetallic-compound alloys in this connection. They combine metallic and ceramic properties. They are between ductile superalloys based on nickel, titanium alloys, and the brittle, extremely high-melting ceramics like zirconium dioxide, aluminum oxide, silicon nitride and silicon carbide.

The good high-temperature stability and creep resistance of intermetallic alloys is caused by the metallic and covalent bonds in the ordered crystal lattice. Intermetallic alloys have comparatively low density. In addition they have satisfactory fracture toughness, are relatively easily workable (ductile) and are extremely resistant to corrosion by hot gases. Their oxidative properties are based on the formation of protective surface layers owing to the high content of aluminum or silicon in the alloy. An additional advantage is the fact that these alloy components are inexpensive and occur relatively frequently in the earth's crust. By using intermetallic alloys at temperatures far above 1100 degrees in stationary and non-stationary gas turbines and rocket and motor vehicle engines their operating temperature can be increased and thereby their economic efficiency be improved and pollution emission be reduced. Of the great number of intermetallic compounds, nickel and ferro-aluminides (NiAl, Ni_3Al, FeAl, Fe_3Al), titanium aluminides (TiAl, Ti_3Al), the high-melting silicides (Ti_5Si_3, $TiSi_2$ and $MoSi_2$) and the extremely lightweight Mg-Mg_2Si are of importance for engineering.

Extensive investigations for the purpose of "processing" and clarifying the interaction between the structure and properties of this new generation of high-temperature materials are being carried out at the Max Planck institutes for iron and steel research and metals research in Duesseldorf and Stuttgart, respectively, in collaboration with the Hamburg-Harburg and Aachen technical colleges, as well as the Geesthacht Research Center (GKSS) and various industrial firms.

Lightweight-construction alloys having extremely low density based on Mg-Mg_2Si and Al-Mg_2Si are being developed for rotating and oscillating components in reduced-fuel-consumption internal combustion engines. In pistons in gasoline and diesel engines these materials make possible a saving in weight of more than 25 percent with a simultaneous increase in operating temperature from 300 to 400 degrees. The technical application requires an optimal combination of metal-physical and technological properties (thermal expansion, thermal conductivity, high-temperature stability and thermal shock resistance) that are achieved by the selective tuning of a fine-grained microstructure.

The "refractory" titanium silicides Ti_5Si_3 and $TiSi_2$ are useful for highly stressed combustion chamber linings and hybrid-design guide vanes. The special crystal structures and the high bond energies make these intermetallic compounds especially high-temperature stable. Unusually high yield stresses are still attainable at test

temperatures of 1000 degrees. Their high compliance constants and their superior resistance to oxidation are additional advantages. Local stress concentrations and residual stress conditions in massive components that lead to cracks are reduced by stress-induced "twinning" in the microstructure. Accordingly, this material has improved toughness properties as compared to ceramics.

Titanium aluminide is the best one suited for oscillating engine components like valves and piston rods as well as for rotating blades and wheels in the high-pressure stages of axial-flow compressors up to operating temperatures of 800 degrees and above. These intermetallic alloys are in the advanced stages of development. Their ultimate strength relative to their low density of 3.6 grams per cubic centimeter makes titanium-aluminide-based alloys especially attractive for high-powered engines and jet engines. Titanium aluminides are also to be used as sheets for fuselage structures and engine parts in future aerospace programs like the American NASP (National Aerospace Plane Program) and the German Saenger program. TiAl base materials that are ductile at room temperature and have high fracture toughness that are superior to commercial titanium alloys are being developed in the materials engineering department at the Max Planck Institute for Iron and Steel Research. The first trial runs of TiAl valves in Daimler engines have been successfully concluded, so that production ready for mass production will be the next goal of the promising development.

Ni_3Al and NiAl are to be mentioned among the nickel aluminides. Ni_3Al was transformed into the ductile state by additions of (doping with) boron at Oak Ridge National Laboratories. Deposits of 0.3 parts per thousand at the grain boundaries markedly improve cohesion strength. The optimal application temperatures of intermetallic Ni_3Al materials modified with chromium, zirconium, iron and boron come to about 1150 degrees. Strong softening with the increasing attack of oxidation begins above this. But this material is very resistant to cavitation. This is due to local dissipation of the drop impingement energy by "martensitic" transformation. A broad application field for rotating components made of Ni_3Al in water turbines, marine propellers and centrifugal pumps presents itself with this.

Nickel aluminide, NiAl, and the intermetallic compounds cobalt aluminide and ferro-aluminide are suited for highly thermally stressed engine parts because of their extreme melting points and excellent oxidation resistance. Chromium, niobium, rhenium and molybdenum fibers, which directionally solidify in a steep temperature gradient of molten alloys, serve as strengthening components. Optimized alloys of these intermetallic materials are presently being tested for their use in jet engines to temperatures of 1250°C.

Germany: Research in Boron Carbon Nitrides

93WS0235C Frankfurt/Main FRANKFURTER ALLGEMEINE in German 20 Jan 93 p N2

[Text] Diamond is still considered to be the material with the greatest hardness. Recent works on the production and characterization of "ultrahard" materials ("Advanced Materials," Vol. 4, p. 759) show that the diamond's leading position here may soon be challenged. For instance, recently an American research group succeeded in producing a carbon nitride with astonishing mechanical properties. The compound was deposited on special glass and metal surfaces as a thin crystalline film. Initial tests of hardness, in which a tiny diamond point is pressed into the layer, left no indentations in the surface of the layer. This result could have two explanations: either the material is very elastic, or else it is harder than diamond. There are theoretical considerations which speak for carbon nitrides having very great hardness: at the end of the eighties calculations for a hypothetical carbon nitride yielded a hardness which was said to be comparable to that of diamond ("Science," Vol. 245, p. 841).

Research is being done at the Max Planck Institute for Metal Research in Stuttgart on another class of compounds—boron carbon nitrides. These are mixed compounds made up of carbon and boron nitride. Analagously to carbon, which occurs in two modifications—one being soft, electrically conducting graphite and the other hard, non-conducting diamond—there are also two modifications of these mixed compounds. While numerous syntheses are already known for the graphite-like, soft variant, work is still being done on a suitable and technically applicable procedure for the production of the diamond-like form. In the opinion of Ralf Riedel of the Max Planck Institute in Stuttgart, a layering procedure in which the material is chemically deposited from the gaseous phase (chemical vapor deposition—CVD) could achieve the goal.

To obtain the diamond-like variant the attempt has been made to have the boron carbon nitride grow on a substratum with similar crystalline structure. It remains to be seen whether the compound obtained in this way will really be as hard as or even harder than diamond. Earlier measurements on cubic boron nitride which had been treated with carbon are certainly very promising: tests indicated that the material was harder than diamond. However, these measurements have not yet been reproduced.

Along with the actual synthesis of ultrahard materials, a reliable determination of their hardness will be an important focal point for future research. Not until the new substances have been characterized with regard to their hardness with the utmost accuracy will diamond perhaps have to lose its reputation as the hardest of all materials.

AEROSPACE

ESA Discussion on Contributions, Currency Fluctuations

93WS0235A Frankfurt/Main FRANKFURTER ALLGEMEINE in German 15 Jan 93 p 17

[Text] Bonn, 14 January—Conflicts between the member nations of the European space organization ESA arising from currency fluctuations are to be avoided in future. A working group appointed by ESA's Council of Ministers in Granada is now considering this matter for the first time. Following difficult negotiations, a compromise had been found after Christmas to deal with the effects of the currency fluctuations of the previous September and October. Since the European space organization came into existence, there has been debate about the extent to which payments to ESA headquarters should be corrected for countries which devalue or revalue their currencies after serious changes in currency. The conference of ministers in Granada was seriously encumbered by a quarrel about how much revaluing countries should be repaid and how much devaluing countries had to add to their payments.

This quarrel stems from the current system for billing and paying contributions in ESA. The space organization's budget, with main office in Paris, is stated in ECUs. The member nations pay their contributions after converting them to national currencies. When a country's currency is devalued, it has more to pay. On the other hand, a revaluing country has a right to reimbursement of parts of its contribution. Every member country pays ESA three times a year. The adjustment of contributions after changes in currency takes place two years later.

The ESA council decided on an interim solution for the adjustment of contributions in 1992 and 1993. According to the ESA regulation, adjustment to the changes in exchange rate will be carried out in 1994 and 1995. On the basis of the compromise, the revaluing countries will have only 50 percent of their claims to reimbursement honored, instead of 100 percent. The devaluing countries need to make additional payments of only 35 percent. A balance between reimbursements and repayment obligations is to be achieved by currency gains at ESA headquarters. The German Agency for Space Affairs (DARA), which led the negotiations, says that this compromise, reached after "highly controversial" discussions, is a barely acceptable outcome for all involved. Professor Wolfgang Wild, general director of DARA, and commercial managing director Dr. Wolfgang Grillo said during a conversation with the FAZ that all delegations worked constructively for a solution of the conflict during tension-laden negotiations involving a lot of money.

The revaluing countries had a claim of DM180 million in all according to the current system; Germany would have had to be paid the equivalent of DM60 million and France DM80 million. The DM30 million which Germany will receive according to the compromise had already been removed from the DARA budget by the Bundestag's finance committee with admirable foresight. Thus the total budget decreases from DM1.232 billion to DM1.202 billion. The gap cannot be closed from ESA reimbursement payments, since these will not be received until 1994 and 1995. But Wild points to the fact that DARA has to pay ESA DM8 million less this year. This low payment comes about because in the December conference the general director of ESA agreed to lower the general expenses of the main office by DM40 million. The total additional payment obligations of devaluing countries in ESA amount to DM210 million according to the existing system of billing and contribution. Most of this is the responsibility of Italy, Great Britain and Spain. Spain and Great Britain in particular had objected to the additional payments in Granada. In connection with this they questioned their contribution for the European laboratory (APM) which is to dock with the planned American space station Freedom. Following the currency compromise, Spain and Great Britain intend to pay their originally prescribed 3 ½ percent share of APM expenses. But 5 percent of the financing for the APM is still lacking, and the general director of ESA is to find a way to cover this by negotiating with member countries.

ESA's Eureca Program Nearing Completion

93WS0241A Paris AFP SCIENCES in French 21 Jan 93 p 5

[Unsigned Article: "EURECA Has Completed Three Quarters of Its Planned Experiments"]

[Text] Paris—More than five months after Eureca (European Retrievable Carrier) was launched on 31 July, its program of scientific and technological experiments is three-fourths completed. The remaining planned activities should be finished in mid-February, according to an ESA announcement on 18 January.

The space shuttle Endeavor is scheduled for launching aboard the STS-57 flight on 28 April, and in early May will retrieve the platform, currently flying at an altitude of a little under 500 km, together with its experiments and samples.

The experimental scientific and technical data is transmitted electronically to users with minimal delay. To date, more than 122,000 requests for data (about 800 daily), from various far-flung laboratories and researchers, have been answered through the Eureca data distribution system (DDS) at ESOC, the ESA's space center in Darmstadt.

ESA stated that "the fact that the mission is being successfully carried out testifies to the validity of the concept of using an autonomous satellite to conduct complex space research. On-board operations are preprogrammed, but are commanded as well during the

brief daily contact periods with the control center, which amount to a total of only 5 percent of the mission's time."

Italian Space Projects, Contracts Reported

Mini-Satellite Launch

93MI0268A Rome SPAZIO INFORMAZIONI in Italian 19 Dec 92 p 3

[Text] The first Italian micro-satellite Temisat-1 (Telespazio Micro-Satellite) constructed by Kayser Italia for Telespazio will be launched into orbit by a Russian Tsyklon launcher in June 1993. Temisat will be placed into a low earth orbit by the Russian Meteor-2 satellite. It will weigh 40 kilograms and will be used for the collection and retransmission of environmental data. The Telespazio-Kayser Italia contract is worth roughly 10 billion lire and calls for the development and launch of two identical micro-satellites. Kayser Italia, which will build the satellite with the German company Kayser Threde, is currently working on the biological experiments Biopan (carried on the Russian Photon-8 capsule launched in October), and Biobox (whose mission in orbit is scheduled for this December under the Russian Bion-10 program). Both were developed under a European Space Agency (ESA) ESTEC [European Space Research and Technology Center] contract.

Kayser Italia Managing Director Eng. Alfredo Zolesi stated: "The experience acquired from our collaboration with Russia, the detailed knowledge acquired on the interfaces and procedures connected with Russian satellites and launchers, and the flexibility and high level of individual professionalism found in small private Italian companies, makes us ideal partners for anyone in Italy and Europe interested in microgravity and micro-satellites."

Low Earth Orbit Satellites

93MI0268B Rome SPAZIO INFORMAZIONI in Italian 19 Dec 92 pp 3-4

[Text] Italspazio, an Alenia group consortium, has recently completed a study for Inmarsat on a small, low earth orbit satellite system for personal cellular telecommunications. Under the five-month contract, which is part of the Inmarsat Project 21, Italspazio designed a system of 40 Leostar-E40 mini-satellites (weighing 300 kilograms each, 780W power installed on board, and a capacity for 2,400 simultaneous phone calls), arranged in groups of eight satellites on five different orbital planes at a distance of around 1,360 kilomters. According to Italspazio: "Mini-satellites in a low earth orbit are a winning alternative for personal communications using cellular telephones, since it is easier to get a wide range of frequency reuse. The costs go up when higher orbits are used to provide earth users with the same power density and number of circuits and hence the same service quality and capacity. Furthermore, a low orbit system can be perfected with an additional capacity for communications between satellites in the same orbit. This results in fewer earth stations being needed, the availability of the service in maritime areas, and enhanced flexibility. By using this kind of system (such as the Globalstar system developed by the American company Space Systems/Loral that can technically be incorporated into the Inmarsat project), European postal offices could export new telecommunications services and expand their markets."

Even the European Space Agency (ESA) is assessing the prospect of providing support to European industries in the sector of personal cellular communications via satellite, a sector in which the United States is already well represented with the Iridium project by Motorola. "This kind of initiative is not new for Italspazio," commented the consortium experts, "which has already dedicated itself to the study of the European Leocom, Leostar, and Iridium-like projects, and also to the Leostar-E40 project for Inmarsat. One thing is certain however, if Italy wants to maintain a competitive position, the support of the Italian Space Agency (ASI) will be indispensable in creating exports out of Italian projects."

Microgravity Experiment

93MI0268C Rome SPAZIO INFORMAZIONI in Italian 19 Dec 92 p 4

[Text] The experiment on the physics of fluids in microgravity performed by the MARS (Microgravity Advanced Research and Support) center of Naples, which was launched from the Kiruna launch site (Sweden) in November aboard the European Space Agency (ESA) Maxus-1B rocket probe, gave some highly interesting scientific results. The experiment was performed by the MARS center in cooperation with Techno System Developments of Naples and was monitored by the laboratories of the Neapolitan center through a connection with the Olympus satellite. "The experiment," they commented at the MARS center, "proved to be extremely useful in understanding how fluids behave in microgravity and in preparation for a similar, more important experiment to be performed aboard the Spacelab-D2 mission in early 1993."

Germany, Russia Step Up Joint Hypersonic Technology Research

93MI0317 Germany, Russia, Step Up Joint Hypersonic Technology Research

[Text] Preparations for technological cooperation under the hypersonic technology funding program have been under way with Russian research institutes and firms since 1990. After two visits by ministerial delegations during 1991, three teams of German experts visited various firms and research institutes in the Moscow area in May 1992, where they identified and defined possible joint projects for the three key technology fields of air-breathing engines, aerothermodynamics, and materials and design.

Since mid-1992, the TSAGI (Central Aerodynamics Research Institute) at Zhukovski near Moscow has been contributing theoretical and experimental studies on hypersonic ramjet engines with supersonic combustion (SCRAM) to the work on propulsion being carried out under the German hypersonic technology program. This technology is of decisive importance for extending deployment potential beyond Mach 7. The first series of joint trials, which are being used to study the influences of various technical parameters such as pressure, temperature, flow speed, and mixing ratio, have been under way since August 1992. There are German propulsion experts on site taking a direct part in this work.

At the same time, joint work on ramjet engines with subsonic combustion (RAM) has begun with the CIAM (Central Propulsion Technology Institute). Considerable insights and experimental successes have already been achieved for this type of intermediate (four to seven) Mach range propulsion under the BMFT [Federal Ministry of Research and Technology] hypersonic technology funding program.

As regards aerothermodynamics, preparations are under way for measurement programs in a Russian hypersonic wind tunnel. These trials, which will be carried out at the TSNIIMASH (Central Mechanical Engineering Research Institute), are intended, first and foremost, to establish the efficiency of Russian wind tunnels. German and Russian experts will establish aerodynamic correction values and study specific aspects of boundary layers with a wind tunnel model already tested in Germany and Sweden; joint experiments will subsequently be performed to clarify aerothermodynamic principles and configuration problems.

The materials and design technology area will draw primarily on Russian know-how regarding materials that withstand high temperatures and the associated processing methods, such as that acquired with the Russian Buran space shuttle. The TSAGI heads a group of Russian firms that will use their own know-how, materials, and methods to design, produce, and test in realistic conditions a structural component subject to high thermal stress: a section of a "hot wing." The results will subsequently be compared with those obtained under the German hypersonic technology program.

Another project aims to develop a complex structural component made of carbon fiber-reinforced carbon and subject to high thermal stress, with a long-lasting antioxidation treatment. This would represent a significant advance in the solution of current problems regarding materials exposed to extreme termperatures.

In all three areas referred to above, the joint aim is to demonstrate the viability of the technologies developed, first in ground trials, then in flight tests. The next stage will thus comprise joint studies as to the utility of large-scale Russian test facilities and the design of possible flight test stands.

Further information may be obtained from the BMFT Hypersonic Technology Project Support Team, IAG-BmbH Dept. TRT, Einsteinstr. 20, D-W-8012 Ottobrunn, tel. 089/6088-357.

Preparations for Second Spacelab Mission Near Completion

93MI0320 Bonn TECHNOLOGIE-NACHRICHTEN MANAGEMENT-INFORMATIONEN in German 15 Jan 93 pp 10-11

[Text] On 25 February 1993, the American space shuttle Columbia will take off from Cape Canaveral, Florida, for a nine-day flight around the earth; the second German spacelab mission "D-2." The shuttle will host the Spacelab, a space laboratory commissioned by ESA [European Space Agency], built under German supervision and equipped with testing and measurement instruments. The crew of seven includes two German scientific astronauts, the physicists Hans Schegel and Ulrich Walter. Both of them, like their American collegues Jerry L. Ross, Charles J. Precourt, and Bernhard A. Harris, have just completed their D-2 mission training in Germany and will fly to the United States within the next few days to start training for the launch, which is scheduled for 25 February.

Like D-1, the D-2 Mission is again headed by Germany. It involves 11 European partners from within the ESA organization, plus NASA, the French space agency CNES [National Center for Space Studies], and Japanese industrial companies. D-2 will focus on basic and applied research into materials, materials processing, biology, and medicine. This mission will also be used for earth reconnaissance, astrophysics, and radiation exposure measurement projects. These latter experiments have been set up in the shuttle's loading bay, as they require direct access to space and not, unlike the research carried out in the space laboratory itself, the direct intervention of the crew.

The research programs involve 36 institutes from over 27 German universities, three major research establishments (DLR [German Aerospace Research Institute] the Fraunhofer Society, and the Max Planck Society), and nine German industrial companies. Another 22 foreign university institutes and other industrial companies are also taking part in this mission. The university of Bremen will take this opportunity to launch a satellite that it has developed to study the physical processes involved in the reentry of space vehicles into the atmosphere and measure the thermal conductivity of liquids replacing CFHCs [chlorofluorohydrocarbons]. About 93 experiments are scheduled during the nine-day D-2 mission, which involves well over 200 scientists and research teams. Germany has 64 experiments, industry being involved in 25, mainly joint projects.

Most of the D-2 research work is the continuation of experiments performed during former missions with more efficient apparatus and with the benefit of the results achieved on additional missions, like the TEXUS

rocket program. But this mission also includes new projects, for example initial tests on new automation, robotics, and remote control procedures. These major new methods will break new ground in the design, operation, and control of space payloads and laboratory units needed for the challenging experiments that will take place both in the space station and on automated unmanned platforms.

The complicated laboratory facilities for materials and life science experiments will, however, continue to require a human presence in space to monitor and regulate the experiments. Whenever possible, however, unmanned automated systems are used even in the manned space station.

The German Space Agency (DARA) is at the head of the D-2 program, while the DLR is in charge of the projects. The Scientific Project Management team for D-2, on which all the D-2 experimenters are represented, bears overall scientific responsibility.

The DLR is training the scientific astronauts, and will monitor payload operation in the space laboratory during the mission from its space control center in Oberpfaffenhofen, which has been expanded to become the manned space mission operation center for D-2 and the subsequent space station. The on-board experimental programs will be monitored and controlled by the experimenters at the center, working in constant contact with the astronauts. To increase efficiency and improve results, these experimental programs are also backed up by a parallel ground program at the DLR user center in Cologne.

The cost of the D-2 mission, which involves the operation in space and subsequent recovery of scientific equipment weighing over 3,500 kg, totals 890 million German marks [DM] (for the period 1987-1995), with NASA launch and service charges accounting for DM250 million; DLR mission management and operation for DM180 million; payload integration by German industry for DM130 million; and apparatus and experiment development by research and industry for DM330 million. Companies participating in the latter include DASA [German Aerospace] (ERNO Space Engineering) and small and medium-sized enterprises such as DHB System, Kayser Threde, and others.

Despite the high number of research programs covering the various areas and manned operation, the cost of D-2 by no means exceeds those of advanced satellites, such as those required for extraterrestrial research or earth observation. According to ESA, the Hipparcos astronomy satellite has an estimated cost of DM800 million, while the European earth reconnaissance mission ERS-1 is costing about DM1,400 million.

Funding is also provided by international partners like ESA, NASA, and Japanese industry, which have contributed a total of DM130 million. The DLR is contributing DM120 million in the form of personnel, goods, and services. The BMFT has granted DARA DM640 million in project funding.

German Firm Opens Advanced Aerospace Test Center Near Madrid

93MI0341 Bonn DIE WELT in German 11 Feb 93 p 7

[Text] The Luebeck firm Draegerwerk AG has commissioned Europe's most advanced test center for aerospace components at the Spanish town of Tres Cantos, near Madrid. The center will carry out tests on impact and vibration, besides pressure, air humidity, and temperature. Computer programs simulate the different environmental conditions, ranging from hot desert climates to icy high altitudes. The center has cost 7 million German marks [DM]; the firm plans to use its own test chambers, each of which has a volume of around 1.5 cubic meters, to test such matters as the fitness of oxygen masks for use in aircrafts. A company spokesman stated that the center would also be available for use by other manufacturers.

AUTOMOTIVE INDUSTRY

Italian, French Automobile Plant Focuses on Manpower

93MI0310 Milan ITALIA OGGI in Italian 1 Feb 93 p 36

[Text] The Sevelnord-based plant, which is about to be built by PSA (Peugeot-Citroen) and Fiat in Hordain, will focus on man rather than the robot and on the "factory worker" rather than the engineer. By 1995, the plant will employ almost 3,500 people engaged in the production of a range of "monospace" (the equivalent of Renault Espace) automobiles to be marketed under the names of Peugeot, Citroen, Fiat, and Lancia. SEVEL (European Light Vehicle Company) is 50-percent owned by the French and Italian groups. It was established in 1978 and already has two plants in Italy that manufacture small vehicles. Peugeot is the Sevelnord project leader. According to Peugeot Deputy Director General Jean-Louis Silvant: "We want to combine quality and simplicity" in development and assembly. He added that "the engineer must take lessons from the factory worker; it will be a factory of the future but not a futuristic one." This means that the goal will not be "to automate everything," which has been very much in vogue in French plants over recent years. The principle that the robot is cheaper than man, works faster, and does not make mistakes, has not gone far. In practice, a position filled by a robot often creates an extra position for maintenance of the machine, Peugeot admits. As for repeated breakdowns, they often cause more damage than would a typical social conflict. From the point of view of quality, productivity, and improved working conditions, the advantages of automation are evident in sectors such as the automobile chassis (padding and welding in particular), or painting. The advantages are less in finishings, and complex assembly operations

(dashboards for example). The omnipotent engineer and his criticism are also on the agenda. The plant only needs "two masters: the customer and the factory worker," this is the message being pounded out by the project leaders. However, Peugeot acknowledges that the Sevelnord model cannot be transferred anywhere. First because the plant, having started from scratch with its new staff, has no tradition nor does it have an industrial substrate to modify. Its production capacity is relatively modest (500 vehicles a day compared to 1,500 at Peugeot-Poissy) and allows for the use of less automation.

France: Electric Car Fleets To Operate in 22 Cities

93BR0383 Paris INDUSTRIES in French Dec 92-Jan 93 p 6

[Text] Twenty-two experimental sites[1] have been selected by the Ministries of the Environment and of Industry for establishing an urban electric car network. These include three cities and two sites that are pioneers in the matter: Chatellerault, la Rochelle, Tours, Saint-Palais (Belle-Ile), and Sophia-Antipolis.

La Rochelle is the precursor of such an urban network. As early as a year ago, an initial agreement was signed between the city, the PSA [Peugeot] group, and EDF [French Electricity Company]. By September 1993, the agreement will result in 50 electric Peugeot 106 and Citroen AX cars being put into circulation, with EDF installing some 100 charging points. The city, in turn, will handle fleet maintenance and management. In fact, by using a magnetic card, the citizens of La Rochelle will be able to borrow a car at a public parking lot and give it back at another lot, where it will be recharged. This is a sort of "nonpolluting individual public transport." If the experiment is successful, 300 cars will be put into circulation in the city.

The city of Tours also plans a similar infrastructure for 1994. As regards Chatellerault, which has already been using electric cars since 1986, this city will install charging stations for the general public in the near future.

The number of cities applying for this experiment on a truly large scale has far exceeded expectations: No fewer than 50 cities applied, but only 22 were selected! But, patience, general usage of electric cars in the entire French urban network should become a reality in 1995!

Footnote

1. The other cities in addition to the five pioneer sites are: Avignon, Bordeaux, Cherbourg, Douai, Grenoble, Le Havre, La Roche-sur-Yon, Lyon, Montigny-les-Cormeilles, Montreuil, Nanterre, Nantes, Nevers, Rouen, Saint-Quentin-en-Yvelines (associated sites: Versailles; the Saclay plateau; the Billancourt area), and Strasbourg.

Paris Implements Real-Time Traffic System

93BR0399 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 28 Jan 93 p 20

[Article signed Y.A.: "With SIRIUS, Drivers Will See Further Than Their Hood"]

[Text] Some 1,500 electromagnetic sensors, 280 cameras, and 70 variable message sign posts will be implemented to improve traffic conditions on motorways in the Paris region.

For one week now, the 175 kilometers or so of speedway in the northeast of Paris have been equipped with a system, centralized at Saint-Denis, whose objective is to gather, process, and diffuse information on the traffic situation to road users in real time. An information-based action program, in a way, as it gives road users a way of looking further ahead than the hoods of their cars, pending the introduction of future onboard radio guidance systems (RDS [relational data system] or others).

There was a definite need: The 28 biggest traffic jams occur in the Paris region where, each year, road congestion increases by 16 percent. The SIRIUS project (work on the SIRIUS [Information System for an Intelligent Network for Users] project started in 1990; the overall program will cost more than 1 billion French francs [Fr]), whose first phase has just been completed, should eventually cover the entire 500 kilometers of motorway and speedway in the Ile de France region. This is a European first which, according to its promoters, designers, and managers (the Regional Equipment Directorate of Ile de France and the SIER, the Interdepartmental Road Operations Service), marks the entry of road traffic control into the industrial era and "promises a more global system which should, at a later stage, allow the dissemination of information directly inside the vehicle," stipulates Yves Durand-Raucher, the director of SIER in Ile de France.

300,000 Data per Second

In the initial stage, the system implements some 1,500 road-embedded electromagnetic sensors at 500-m intervals to detect the passage of cars. These are interrogated by the system every 5 meters. "This enables us to measure, from one sensor to another, the speed of cars and the passage of trucks; the output of the sensors give us indications on traffic slowdowns and possible traffic congestion," explains Patrick Zmirou, an engineer at SDEL (Saunier Duval Electricity), the prime contractor for the project's hardware, i.e., equipment for data acquisition and transmission and for energy transportation. Some 6,000 kilometers of fiber-optic cable have been used to link the sensors to the 20 technical sites, to the six network concentrators, and to the operating center, where data is processed by two front-end HPs [Hewlett Packard] which are linked via an Ethernet network to two HP-9000s running an expert system

especially developed by STERIA [Research and Development Company for Information Technology and Process Control]. (The data transmission networks use MIC [coded pulse modulation] coding at 36 Mbit/s [56 64-Kbit/s channels].)

"The system analyzes 300,000 data per second. Based on data input, it drafts messages and identifies the signposts where they will be displayed," explains Francois Enaud, director of STERIA's road and rail transport department. The system also controls the traffic lights giving access to motorways and it defines alternative itineraries in the event of accidents or major roadworks. The second phase, which involves the entire southeast sector of Paris, will be operational mid-1993. Completion of the entire program, covering all of the Ile de France area, still requires the implementation of some decisions made within the scope of the 1994 planning contract, in particular, the linking of the western Paris area through the A86 and A104 ringways. It will implement 4,000 electromagnetic sensors, 480 cameras, and 250 illuminated variable message signposts. There will be 110 monitored access points and four operations centers will be required to run the whole network.

This system, whose aim is to become a "superpilot" project among the European transport-related data communications projects, is not destined to function in isolation. Information will be shared with the city of Paris, which is working on a project for traffic light control.

BIOTECHNOLOGY

Germany: Photosynthesis Research To Obtain Hydrogen

93WS0221B Duesseldorf HANDELSBLATT in German 14 Jan 93 p 20

[Article by Silvia van der Weiden under the rubric "Research and Technology": "Biotechnology/Scientists Want to Use Plant Cells As a Hydrogen Source. Harsh Genetic Engineering Gun Is to Bring 'Green Power Plants' up to Maximum Capacity"; first paragraph is an introduction]

[Text] Wednesday, 13 Jan 93 (HANDELSBLATT)—One of the most successful processes of all time was developed as far back as over 3.5 billion years ago: photosynthesis. Here energy is converted into the form of power by means of sunlight, carbon dioxide from the air and the chemical dissociation of water. In view of its considerable efficiency of a total of 40 percent, nature offers a brilliant plan for power generation and does so free of charge besides. Now researchers are tempted by the idea of "tapping" photosynthesis for man's energy supply.

The obvious reason for the heated interest of scientists: Hydrogen that can be utilized commercially for energy is produced inside plant cells in a biochemical branch of the complex reaction occurrence—photolysis. This takes place in all green plants and several microorganisms within particular cell organelles, chloroplasts. And it is precisely on this point that biotechnologists are now trying to act. If the "green power plants" of plant cells can be made to produce sufficient quantities of hydrogen, then the dream of inexpensive and non-polluting energy could perhaps become a reality.

Oxygen Still a Headache

However, a significant problem that biotechnologists still have to contend with at present is the instability of the key enzyme for biological hydrogen production—hydrogenase. It influences an extremely complex and linked reaction occurrence inside chloroplasts. However, photosynthesis yields not only the sought-after hydrogen, but also produces the oxygen necessary for our lives.

This reactive oxygen is also what gives researchers quite a headache, because it in turn attacks the essential enzyme, hydrogenase. Now Professor Cornelius Friedrich's study team at Dortmund University is trying to get a grip on the problem by switching to microorganisms with hydrogenase that is less susceptible to oxygen. By means of optimal culture conditions and constant selective breeding, the Dortmund microbiologists have succeeded in getting their green algae to produce at least 50 percent of the biologically possible quantity of hydrogen.

Biologists at Ruhr University in Bochum are now attempting to follow another promising course in this direction. Professor Achim Trebst's study group has envisaged the genetic engineering optimization of hydrogen-producing green algae. The scientists are falling back on a really unusual tool in order to be able to work their way through to the genes of their test organism: They are firing with a small laboratory gun volleys of miniscule shot at their green algae cultures. The ammunition acts as a "Trojan horse" for them here, because foreign genetic information adheres to the surface of the just one-thousandth of a millimeter in diameter shot. The genetic central control station of photosynthesis, the chloroplasts, is of course the aimed-at target of the unusual action.

The biotechnologists hope to be able to let the foreign genetic material into the robust green algae by means of this, though harsh, nevertheless quite simple method. Ultimately a more stable hydrogenase is to be able to be produced in this way.

As things now stand it sometimes happens that the shot fired and loaded with the foreign genes also is left stuck in the vicinity of the chloroplast genetic information. It even happens in extremely rare cases that the foreign genetic information is incorporated in addition into the particular genetic material as well as at the intended place—the gene for hydrogenase. Because the success or failure of the manipulation cannot be easily observed in the green algae cultures, one more marker is introduced

in addition in the foreign genetic information passed in. Thus those cells in which the trick resulted in success can be picked out from the millions of others.

Much Necessary Experience Still Lacking

Of course the ordeal apparently makes no difference to the resistive green algae. Although each "hit" leaves a small hole in the cell, nevertheless special repair molecules of the microorganisms take care of closing the wound quickly and safely.

Basically, the Bochum researchers say, although the process has been tested, nevertheless for successful manipulation of the organisms experience is thus far still lacking as to how the genetic material let in has to be constituted in order to produce the effect of a more stable hydrogenase or even of more efficient hydrogen production.

In order to let light into the darkness of the complicated phenomena at the molecular level here, scientists are presently working on clarifying the various strategic points of photosynthesis. They are attempting to clarify by means of special gene probes the structure of photosynthesis molecules and to get behind the secrets of the complicated energy machine. In spite of the many advances just in recent years, biotechnologists leave no doubt that it will still be some time before the efficient utilization of "green energy."

Biosensor Research in Berlin Detailed

93WS0235B Frankfurt/Main FRANKFURTER ALLGEMEINE in German 20 Jan 93 p N3

[Article by G. Hartmut Altenmueller: "Biosensors Conquer More Fields of Application"]

[Text] The highly sensitive sense organs of living creatures are the basis for a new and very promising technology. The fields in which biosensors could take the place of previous techniques include medical diagnostics, control of processes in the chemical industry, waste water monitoring, food monitoring and drug searching. These sensors give the desired values in a matter of a few minutes, rather than several days. They are not confined to the laboratory, but can be used on the spot, can be miniaturized and can recognize the tiniest concentrations of materials. Their high sensitivity and discrimination make it possible to investigate chemically complex problems without setting them up specially.

In a biosensor which is measuring the glucose content of the blood, for example, smaller molecules pass from the solution under investigation through a membrane into a gelatinous solution such as gelatine or polyurethane. The glucose oxydase enzyme is "trapped" by the sandwich principle between the first membrane and a second one. It reacts only to the substance which is to be analyzed. The enzyme divides it into gluconolactone and hydrogen peroxide. Peroxide is converted to hydrogen and oxygen molecules at an electrode (transducer), giving up two electrons per molecule in the process. The glucose concentration can be deduced from the resultant electric current.

A blood sugar measuring device of this type and an apparatus for measuring lactic acid have been developed by a research group at the biological-medical institutes of the former Academy of Sciences of the GDR in Berlin-Buch. They are the first commercially available devices of this type in the world and are now being produced by a company in Magdeburg. For Germany, reunification brought new stimuli for biosensorics. Today German firms are in third place in the international biosensor market, after Japan and the United States. German researchers are in second place in the world in technical publications and patents, after Japan; at the beginning of the eighties, the FRG was only in sixth place. The largest European company for biosensors is now located in Dresden.

For the moment, the biosensor group in Berlin-Buch is continuing to work in the facilities of the Max Delbrueck Center for Molecular Medicine, but with its leader, Frieder Scheller, it may eventually find its place at a university in the context of the program for the integration of scientists. Scheller has also founded the company BioSensorTechnologie GmbH for further development. The Federal Ministry for Research and Development (BMFT) is supporting both activities, that of the company in the form of indirectly specific support which was felt to be particularly attractive. The first results of the BMFT's "Biosensorics" support project from 1988 were introduced in Bonn at the beginning of January 1993 as part of the "Technologies of the Twentieth Century" initiative. Of the 33 current support projects, 15 are being worked on in eastern Germany, 12 of them in economics.

In medical applications, researchers are concentrating on devices for on-line monitoring of patients, as during operations and in intensive care, and on diagnostics, the analysis of endogenous materials, medications and drugs (doping monitoring). In the case of the pocket measuring devices developed in Berlin for glucose (for diabetics) and lactic acid (for example, for sports medicine), a drop of blood is placed directly on the sensor. In the long run a single measurement with the membrane system, which can be reused several thousand times, could cost a diabetic only a tenth as much as the previous test strips.

In Berlin-Buch several electrochemical sensors have been developed in the last 15 years. According to a report by Scheller and his associates, these sensors were linked with approximately 40 different enzymes, intact microbe cells or plant cells, and antibodies. Fifty sensors have sufficient measurement criteria for applications in laboratory diagnostics, such as for cholesterol, creatin, phenol, glutamate, phosphate, pesticides, ATP, Interleukin 2 and transaminases. So far biosensors for more than 120 substances have been described. However, most of them are not yet ready for use.

As a bridge between biology and technology, requiring interdisciplinary researches, biosensorics can also be used in nonmedical areas. Two companies have developed a measurement system for the analysis of waste water on the basis of a microbial sensor. The microorganisms fixed in the biomembranes feed on the organic components of the water samples, and the electrode measures the Biological Oxygen Requirement (BSB). The more oxygen is used, the dirtier the water is.

In biotechnical procedures like cell culture technology and the production of antibiotics, the monitoring of the concentrations of key substances in the fermenter is important. For many of the materials there are already established enzyme electrodes. Within the biosensor project which is part of the BMFT program "Biotechnology 2000," sensors, several of which are linked sequentially with different enzymes, are being investigated on the basis of Bio Field Effect Transistors (BioFETs) for the simultaneous measurement of various quantities in the process.

Food monitoring employs biosensors to detect alcohols, lactic acid, glutamine and urea; it also uses multiple electrodes for the simultaneous determination of complex properies such as freshness or aroma. Mycotoxins are detected with the aid of glass fiber sensors with fluorescent toxins on them which are exchanged with non-fluorescent toxins on contact with the sample. Variations in fluorescence on the surface of the fiber are used for analysis. Since 1992 science and industry have been developing biosensors for the detection of narcotics. They may be able to replace the drug-sniffing dog. These devices must be able to detect a single drug molecule among 10 billion molecules of air.

Two main directions are emerging for the future. Biological sensor components can be combined with the rapidly developing microsystem technology and microelectronics. This is intended to replace the expensive production of conventional signal converters. The goal is to identify even individual molecules with the appropriate nanotechnology. The other development is in the direction of new biomolecular functional systems for technology. Genetic technology and immunology should provide the impetus for particularly useful reactive compounds. For example, enzymes are being sought which are stable even under extreme conditions and—like the snowball system of blood clotting—strengthen signals. With them it would be possible to construct biosensors of very great sensitivity.

In Berlin-Buch several enzymes have been successfully linked to enhance weak chemical signals biochemically by a factor of more than 10,000. This figure approaches the extraordinarily high sensitivity of sense organs. These researches will lead eventually to highly integrated electronic components which are based on biological structures and principles, "biochips." At the University of Ulm signals were successfully transferred from isolated nerve cells to silicon circuits. Scientists are also considering systems which combine biological and nonbiological components, for example in implantable artificial pancreases for diabetics.

French Researchers Study Effect of Radiation on Bone Marrow Cells

93WS0244A Paris LE MONDE in French
20 Jan 93 p 18

[Article by Ca.V.: "The Laboratory for Radiation Exposure"; first paragraph is LE MONDE introduction

[Text] The Atomic Energy Commission (CEA) and Saint-Louis Hospital have teamed up to study the effects of radioactivity on bone marrow.

When leaders of the French nuclear physics industry meet with world-renowned specialists in bone-marrow transplants, they talk irradiation. And sometimes their words give rise to action. That is how a one-of-a-kind research unit—the product of an unprecedented alliance between the Atomic Energy Commission and Public Assistance—was born in Paris. The laboratory was introduced Tuesday, 12 January, by its codirectors, Edgardo Carosella, the head of the CEA's immunoradiobiology laboratory, and Mrs. Eliane Gluckman, chief of the bone-marrow transplant unit at Saint-Louis Hospital. The goal of the laboratory is to understand how radioactivity affects bone marrow cells, so that specialists can devise better ways to prevent or treat the effects of accidental or occupational exposure to radiation.

The CEA has devoted some portion of its research to the medical consequences of nuclear physics since its inception in 1945. But it was not until 1986 and the Chernobyl explosion that people realized medicine was still largely powerless to mitigate the consequences of a major nuclear catastrophe, and that radiobiology research needed to be stepped up.

"The need is all the more urgent in that serious accidents are only the tip of the iceberg. Very-low-level radiation, to which personnel in nuclear power plants and radiation therapy departments are exposed, can also affect health," points out the CEA's director of life sciences, Michel Suscillon. In his view, learning about nuclear pathologies has become a "national duty."

So research into nuclear maladies will be the main priority of the "hematopoietic stem cell biology laboratory" at Saint-Louis Hospital. Indeed, stem cells, which are produced by bone marrow and are the source of all blood and immune-system cells (red blood cells, white blood cells, platelets), are extremely sensitive to radiation. A dose of six to eight grays (600 to 800 rads) is enough to cause real destruction of the marrow (aplasia). The only effective therapy is a medullary transplant.

"With lower levels of radiation exposure, the administration of active molecules (cytokines, lymphokines, growth factors) can be enough to induce multiplication and repopulation of the damaged cells," says Edgardo

Carosella. But this requires identifying the preferred target cells of the ionizing radiation, knowing exactly how sensitive those cells are, and understanding how their chromosomes are reshuffled, in order to devise the best therapeutic plans on a case-by-case basis.

The Virtues of Umbilical Blood

In its research on bone-marrow cells and radiation the Saint-Louis laboratory uses an invaluable raw material: umbilical cord blood. Indeed, before gestation and before they are produced by the bone marrow, future blood cells form in the vitelline sac of embryos. As a result, the umbilical cord contains a substantial quantity of stem cells at birth. "When a sample of umbilical cord blood is taken—anonymously and at no charge with the informed consent of the mother—a few minutes after birth, it is an irreplaceable material for our research," explains M. Carosella. Each week his laboratory receives the blood of six to eight umbilical cords from various Paris maternity wards. An experimental "bank" of frozen cord blood, which currently contains 300 samples, is also being set up at Saint-Louis Hospital.

Umbilical cord blood is essential for basic research; most important, it has vast therapeutic potential. Although spectacular strides have been made in bone-marrow transplants over the last 20 years, the procedure, which is indispensable for treating the most serious blood diseases (aplasias or leukemias), is unfortunately still highly restricted. "Besides requiring a bone marrow sample from voluntary, living donors[1], transplants demand such a high degree of immunological compatibility between donor and recipient that only 20 percent of the patients waiting for one now find a compatible donor," says Mrs. Eliane Gluckman.

"In comparison, stem cells from umbilical cord blood are a priceless reserve," continues the world-renowned specialist. Mrs. Gluckman successfully performed the first umbilical blood transplant, on an American child with hereditary Fanconi anemia[2], in 1988 (see LE MONDE, 6 December, 1989). "Easy to remove at delivery, umbilical cord blood could be used immediately in case of medical emergencies, or even nuclear accidents. Moreover, and this is vital, it offers more favorable immunological properties for transplants than does adult marrow." Indeed, "inexperienced and suppressive" umbilical blood stem cells reduce one of the major remaining immunological obstacles to bone marrow transplants: the "graft's reaction against the host."

To expand the potential for basic and clinical use of umbilical blood, France and Great Britain are now trying—in cooperation with other European partners[3]—to found a European Umbilical Cord Blood Bank. The goal is to gather 20,000 frozen, stored, and ready-to-use samples over the next two years. The bank will be an invaluable complement to Europe's present register of bone marrow donors. But funding for it, estimated to run at least Fr50 million, still needs to be raised.

Footnotes

1. Established in the late eighties, the European register of potential bone marrow donors now contains 350,000 names, including 65,000 in France.

2. So far, about 20 umbilical blood transplants have been attempted in the world, six of them at Saint-Louis Hospital (see LE MONDE, 22 May 1992).

3. Germany, the Netherlands, Belgium, and Italy took part in a preparatory meeting to set up the European bank in Munich, on Saturday, 16 January.

French-Brazilian Team Develops *Leshmaniasis* Vaccine

93WS0244B Paris LE MONDE in French
22 Jan 93 p 12

[Text] Has a team of French and Brazilian researchers developed, in total anonymity, the first antiparasite vaccine ever discovered by man? A simple "letter" went totally unnoticed several weeks ago when it was published in the medical weekly THE LANCET[1]. Yet the communication may go down in the annals of medicine as the official announcement of something which, so far, has never been done before for any parasitic disease: Namely, proving the effectiveness of a vaccine against *Leshmaniasis*. The disease is widespread in South America, India, and Africa, and affects a total of over 12 million people throughout the world.

The vaccine's story begins in 1985 when Dr. Monjour's team at Professor Marc Gentilini's Tropical and Parasitic Diseases Department (Pitie-Salpetriere Hospital, Paris) succeeded in isolating an apparently vaccinating protein on *Leishmanias*, which are the parasites responsible for the disease. The protein the team isolated is capable of triggering the onset of a protective immune reaction. After experimenting with his vaccine preparation on dogs and monkeys, Dr. Monjour decided to inject himself with it in late 1985 (see LE MONDE, 13-14 July 1986). Then he twice injected himself with the parasite to test the effectiveness of his vaccine.

As the results were conclusive, the next step was to conduct a real vaccinal trial. That has now been done. The trial was conducted on 24 people in a village known to be a big endemic center for the disease: Rede-Grande, in Pernambuco state in northeastern Brazil. (Before it was conducted, the ethics committee of the federal University of Pernambuco approved the principle of the trial.) Two groups of 40 people were recruited; one received a vaccine preparation and the other a placebo.

The vaccinations were given between March and May of 1991, before the start of the rainy season. Over one year after the vaccine was administered, in July 1992, skin lesions typical of *Leshmaniasis* were observed in six subjects of the placebo group. On the other hand, no one vaccinated showed the slightest sign of the illness. Since the yearly frequency of *Leshmaniasis* in the village over

the same period was 13 percent, the difference was considered substantially significant.

For the time being, Dr. Monjour's team is making the vaccine essentially "by hand," having signed no agreement with any pharmaceutical lab whatsoever. "We are now going to resume our animal work, to verify that the vaccine can be made on an industrial scale," Dr. Monjour told us. We will then know whether it will be possible to pursue large-scale vaccination of the some 350 million people in the world who are at risk of developing *Leshmaniasis.*

Footnotes

1. THE LANCET, Vol. 340, 31 October 1992.

British Researchers Begin Testing Cancer Vaccine

93WS0244C Paris LE MONDE in French 27 Jan 93 p 9

[Article by London correspondent Laurent Zecchini: "An Experimental Vaccine Against the Epstein-Barr Virus Has Been Developed in Great Britain"]

[Text] Officials of the British Center for Research Against Cancer (BCRC) announced on Monday, 25 January, in London that an experimental vaccine to combat infection with the Epstein-Barr virus had just been developed. EBV is similar to the herpes virus. If the laboratory tests run so far on a group of 20 volunteers are conclusive, British scientists think the vaccine could prevent the onset of some forms of cancer in Africa and Asia.

The experimental vaccine was developed by Drs. John Arrand and Mike Macket of Manchester, working together with medical teams in Bristol and Birmingham. It is presently estimated that at least 20 percent of all cancers are caused by a virus, and four of the viruses have been identified. Besides EBV, there are the papilloma viruses linked to cervical cancer; hepatitis B virus, which is associated with primary liver cancer; and viruses from the HTLV group, which are involved in some kinds of leukemias.

CRC officials said that if the vaccine is shown to be effective, it will be the outcome of over 25 years of research and investments totaling £5 million since the virus was discovered in 1964. But scientists are cautious. "It could be 10 years before we are able to clearly show that the vaccine prevents cancer from developing," stresses Dr. Arrand.

Footnote

[In industrialized countries, infection with the Epstein-Barr virus causes infectious mononucleosis, an illness that occurs most often during childhood or adolescence. It is characterized by a combination of fever, severe sore throat, swelling of the lymph nodes, blood anomalies, and intense fatigue. The illness quickly runs its course and creates a long-lasting immunity against the virus. The main danger of infection with the Epstein-Barr virus shows up primarily in different African and Asian countries, where doctors have observed a relatively high incidence of cancers affecting either the lymphatic (Burkitt's lymphoma) or nasopharyngeal systems in patients infected with the virus a few years before. The development of an experimental vaccine against EBV infection may therefore be an important step in preventing those cancers, just as the development of an antihepatitis-B vaccine in France in the late seventies was key to preventing primary liver cancer in intertropical areas. However, beyond the question of developing and proving the effectiveness of the vaccines lies that of whether the countries concerned will be able to pay. J.Y.-N.]

Germany: Computer Software Analyzes Cells' DNA Content, Aids in Cancer Diagnoses

93WS0261A Duesseldorf VDI NACHRICHTEN in Germany 29 Jan 93 p 12

[Article by Anne Hardy-Vennen: "Computer Program Recognizes Cancer Cells: TV Cytometer Determines DNA Content"]

[Text] ***VDI-N, Frankfurt, 29 Jan 93***—*Besides a timely diagnosis, a prognosis of the likely course of the disease is an important prerequisite for successful cancer therapy.*

As a rule, the presence of cancer is betrayed by the characteristically altered appearance of the affected cells. In 99 percent of all cases, an experienced pathologist need only peer through a microscope to recognize the disease. To be sure, in a very few cases, the alteration of the cells has not progressed to the point where it is as yet possible to distinguish between a relatively harmless illness and an early stage of cancer.

This "therapeutic crisis" can have serious consequences for the patient so afflicted. In his practice, Alfred Boecking, a pathologist in Aachen, has become aware of cases in which patients have not only been operated on needlessly, but others in which the attending physicians have failed to undertake timely therapy because the nature of the tumor has not been recognized with complete certainty. To avoid situations like these, Boecking has developed a new diagnostic procedure at the Institute for Pathology in the Rhein Westphalian Technical University. By means of the new procedure, Boecking is not only able to determine whether a tissue sample contains cancer cells, but can also ascertain the degree of malignancy. He has been awarded the Wilhelm Warner Prize for Cancer Research for his work.

Boecking's method is based on the fact that most cancer cells have a multiple of the usual double set of chromosomes. This irregular multiplication can be identified by means of so-called DNA cytometry. In the procedure, the pathologist applies a dye, whose precise light transmissivity he knows, to the cells. The more genetic material contained in the cell nuclei, the more light they absorb when observed under the microscope. To date,

however, this diagnostic procedure was only suitable for routine measurements because of the prolonged measurement times involved, unwieldy equipment, and imprecise results obtained.

Through an optimally synchronized interplay between man and computer, Boecking has now succeeded in making extremely precise measurements. In a so-called TV cytometer, the picture of the microscope is fed into a personal computer by means of a television camera. The physician then gradually marks all suspicious cells on the screen. A sophisticated data processing program then assures that the computer knows the outlines of the target precisely and determines its DNA content. In this way, several hundred cells are investigated step by step.

Boecking has deliberately refused to automate the procedure. Only too often samples from routine investigations contain impurities that the computer would wrongly interpret. Human control, on the other hand, assures a much more accurate measurement. The specialist can himself take the varying thickness of the slide preparation into account, while he makes a "blank reading" from the vicinity of the cell for comparison.

First, the measurement is made graphically in the form of a bar graph that shows the DNA content as a function of the measured frequency (histogram). Besides the healthy cells with their double set of chromosomes, there are also cell nuclei with pathologically multiplied or diminished chromosomes. Depending on the type and stage of the cancer, these values can differ greatly. A completely reliable diagnosis is only possible after the data have been analyzed in the computer. The specialists are not yet in agreement on a specific technique of calculation. The computer program therefore operates according to algorithms provided by various experts. In this way, the interpretations of the participating specialists can be compared with each other.

At the same time, the new procedure has many advantages for the patient as well. It not only spares him the consequences of an uncertain diagnosis, but often helps him find a less aggressive therapy. The histogram shows the physician just how malignant the cancer is and how it will develop further. If, for example, the deviation from the normal double set of chromosomes is slight, then there is usually little danger that metastasis will occur. In the case of a patient with a bladder carcinoma in the earliest stage, chemotherapy may be dispensed with after the operation. In the case of prostate cancer in an elderly patient, the physicians may decide to treat the tumor with hormones alone. Similar experiments are currently be conducted in Scandinavia as well.

Besides prostate and bladder cancers, the procedure may also be used to make similar evaluations (gradations) possible for kidney and breast tumors as well. DNA cytometry permits patients with chronic myeloleukemia to exhaust the chronic phase of their disease better, before being subjected to a risky bone marrow transplant. So far, on the basis of smears of the cervix, larynx, bronchial tubes, and sometimes even bone marrow, the method can yield reliable diagnoses of early cancer stages.

Results of German Biosensor Program Reported

93MI0316 Bonn TECHNOLOGIE-NACHRICHTEN MANAGEMENT-INFORMATIONEN in German 15 Jan 93 pp 3-4

[Text] Intelligent sensors and sensor-based control systems, similar to those of living organisms, can significantly increase efficiency, reduce resource depletion, and lower toxic emissions. Biosensors are a particularly vivid example of the principle of "learning from nature." These high-technology sensors of the future can detect the minutest traces of substances rapidly and accurately, exploiting the unique sensitivity and selectivity of the "key-lock" principle of biological components. Since 1988, the BMFT [Federal Ministry of Research and Technology] has been supporting biosensor research and development to the tune of about 65 million German marks [DM]. This has raised over DM25 million in additional private investment and boosted this area of R&D in industry.

The dynamic development of molecular biology and electronics in the eighties had paved the way for the development of biosensor technology. In 1988, the BMFT decided to seize the opportunities emerging in this sector by setting up the Biosensor Funding Program.

So far, 51 projects have been funded. The process that they have set in motion has brought more efficient and cost-effective measurement and analysis systems.

Biosensors have made medical laboratory tests (for example, the blood sugar test) considerably faster, easier, and safer. Intensive medicine relies more and more on biosensor devices for drug dosage and on-line diagnosis (for example, in heart surgery). Other application fields include industrial and sports medicine. Research institutes in the old and new federal laender are working with industry on developing a mobile drug detection unit for use in the fight against drug abuse. Work on food monitoring, for instance, aims to develop biosensors that will detect mold fungus toxins in food preparations or monitor the quality of meat and dairy products. They reinforce the trend towards healthy eating.

Biosensors can also bring progress in environmental engineering. A new effluent monitoring device has been designed to perform field measurements, thus making it possible to replace conventional laboratory tests lasting several days with rapid on-site measurements. The new quality achieved with biosensors can be appreciated, for example, in the event of failures, because action can be taken immediately and considerably more cheaply, and further damage can be prevented. A biosensor device of this type, developed by an eastern German company, was awarded the special "environmental engineering" prize under the 1992 Berlin-Brandenburg Innovation Award. Process control is of major importance to the

pharmaceutical industry in particular. Where maximum purity and stable process conditions are essential. Rapid systems for on-line coupling to bioreactors are being developed in close cooperation with industry, and newly developed devices for identifying selected substances in cultivation processes are already being used. Biosensors are also acquiring testing (for example, as an alternative to tests on animals).

BMFT funding initiatives bring about positive structural changes in industry. For example, the stabilization and reorganization of high-technology companies in the new federal laender and the successful foundation of new companies in both the new and original laender rest on the know-how acquired as a result of joint project funding. Since the beginning of the funding program (1988), the BMFT has contributed about DM65 million (DM40 million in project funding and about DM25 million in the form of institutional funding). In the first instance, this funding program gave a boost to the preliminary research work required on biosensors, with the result that over DM25 million were subsequently raised in the private sector for biosensor research projects, some of which will not have applications until the distant future. Industry's involvement is evident from its participation in scientific projects (50 percent) and its considerable spending on its own research projects that receive BMFT grants (the BMFT contribution amounts to about 30 percent). As a whole, industrial participation in funded projects has steadily increased: At present, 19 out of a total of 33 BMFT-funded projects are being handled by industry. Small- and medium-sized enterprises in particular have been successfully encouraged to convert research results into marketable products.

German companies now rank third behind Japan and the United States in terms of international market shares, and the trend is still upward. Even conservative estimates anticipate that the biosensor market will double over the next five years, with sales of devices involving biosensors expanding many times faster than the market for biosensors themselves. Leading Japanese experts predict a far higher growth rate. This extends, for example, to decentralized devices, including those for home use, for monitoring health, environmental factors, food and so on.

The unification of Germany, with the integration of the former GDR's highly qualified teams specializing in this sector, has spurred on this work. In the new laender, BMFT funding is seen as an opportunity to modernize research and industry. Of the 33 projects funded, 15 are being carried out here, 12 of them in industry. The merging of eastern and western German biosensor research, which has been fostered through BMFT-funded projects, has now made Germany one of the world's leading countries in this sector. (In 1988 the former FRG lagged behind Japan, the United States, the GDR, the USSR, Great Britain, France, and Sweden.) Progress has also been made by joint European projects. For example, a company from Saxony is working on a EUREKA [European Research Coordination Agency] project on new biosensors for medical diagnostics together with British and Italian partners.

Two main trends for the distant future are emerging. In one, biosensor-components will be integrated into microsystems. While in the other, the biological components will take the form of new biomolecular function systems for engineering purposes with special substance synthesis, information processing, and energy conversion applications. In this connection, biological principles that have so far been only minimally exploited for engineering purposes will be fully developed, applications including biochemical signal amplification. A model that still remains unmatched is provided by the millionfold signal amplification that occurs during blood clotting. Following the snowball principle, individual signal molecules activate a number of protein molecules, which in turn activate dozens of others, and so on until the "avalanche" set off during the final stage causes the wound to close. Research workers in Berlin-Buch have already succeeded on amplifying very weak chemical signals biochemically over 10,000 times by coupling several enzymes achieving an output signal quality unprecedented in electronic signal processing. Progress has thus been made towards the extraordinarily high sensitivity of the sense organs of living beings.

Biosensor engineering demonstrates that modern biology is increasingly becoming the driving force in interdisciplinary cooperation and the pioneer discipline for the technologies of the 21st century. According to OECD estimates, biotechnology will mean business for many companies in the first two decades of the 21st century. Many sectors of industry will be affected: the pharmaceutical and chemical industries, equipment manufacturing, electronics, the food industry, the environment sector, and agriculture.

The interdisciplinary merging of high-technology biology, chemistry, and physics has brought innovatory strides forward and revolutionary approaches, encouraging traditional branches and production processes to adopt customized, environment-friendly products and processes. Interdisciplinary structures and a broad view taking in a number of specialities are becoming increasingly important to the planning, performance, and funding of new R&D projects.

DEFENSE R&D

Presentation of Sweden's Defense Industry

93BR0360 Arcueil L'ARMEMENT in French Dec 92 pp 115-124

[Article by Rene Moine, principal armaments engineer at the International Industrial Affairs Subdivision of the Industrial Armaments Affairs Central Service: "Sweden's Defense Industry"]

[Excerpts] [passage omitted] Heir to the Nordic traditions and the current expression of the "Scandinavian

model," once a regional power and, thenceforth (since the end of the Napoleonic Wars), committed to a vigilant neutrality, Sweden has developed an independent defense industry. It rests—in certain respects—on principles similar to our own: strong self-sufficiency; the need to export; and the major role of government.

This article's aim is to provide a view of this defense industry by placing it first of all in the Swedish geographic, institutional, and economic context, and then in its more immediate environment.

National Context

Geography

Sweden has an area of approximately 450,000 square km (0.82 times that of France) and a population of 8.6 million inhabitants, concentrated in the southern portion of the country. Overall, the average population density is low: 19 inhabitants per square km (versus 102 in France).

Institutions

The Swedish monarchy dates back to 1523 with King Gustave Vasa, a parliamentary monarch. The Constitution of 1 January 1975 abrogated the 1809 Constitution.

The head of state is Charles XVI Gustave, heir to the dynasty founded by Bernadette. Parliament (the Riksdag) includes a single 349-member assembly, elected by universal suffrage for three years.

Since the elections of September 1991, the majority has been center-right (a coalition of "bourgeois" parties ranging from conservatives to centrists). Mr. Carl Bildt is prime minister.

Economy

GDP rose to approximately ECU192 billion in 1991 (versus ECU968 billion for France, or a relationship of one to five). (One ECU is worth approximately 7 French francs [Fr].) The monetary unit is the Swedish krona (SKr); in 1991 it was worth Fr0.93.

The Swedish krona was linked to the ECU from May 1991 until the devaluation of 20 November 1992.

Since 1988, the Swedish economy has experienced a slowdown in its growth, which since last year has turned into a recession. Combined with the questioning of the "Swedish economic model," a legacy of the social democrats, this crisis has given rise to the disappearance of the traditional characteristics of this economy, i.e., a low rate of unemployment and a high rate of inflation for a Western country. However, one strong point remains: the foreign trade surplus. (Over 50 percent of Sweden's trade is done with the EC.)

Defense Industry Environment

Foreign Policy

Open to the world, and especially to the countries of the south, but at the same time concerned about preserving its peacetime neutrality intended to keep any European conflict at bay, Sweden belongs to or participates in organizations compatible with that neutrality: the United Nations, the CSCE [Conference on Security and Cooperation in Europe], the Council of Europe, OECD, and EFTA [European Free Trade Association].

Sweden also participates in the Nordic Council (Scandinavian countries plus Iceland) and in the recently created Baltic Sea Council.

EC membership, initially turned down by Sweden in 1971, is again the order of the day for the first time since the official submission of Sweden's candidacy on 1 July 1991. It could become effective in 1995 or 1996 after a referendum.

On this assumption, Swedish neutrality could evolve toward membership in a European system of collective security compatible with its policy of nonparticipation in any military alliance.

In the field of armaments, Sweden has until the recent past refused to become involved in international cooperation. More recently, however, the new government wanted Sweden to join the IEPG [Independent European Program Group] to develop European arms exchanges and industrial cooperation in the defense field.

This pending application must take into account both current IEPG developments and the fact that Sweden is a member of neither NATO nor the WEU [Western European Union].

Defense Budget

For the 1992-1993 fiscal year (1 July 1992-30 June 1993), the defense budget (excluding civil defense) amounts to SKr34.6 billion (approximately Fr32 billion) at February 1991 economic parameters, or approximately one-sixth of the equivalent French budget.

The share of equipment expenditures, evaluated under conditions similar to French Title V [equipment expenditures budget], represents 43 percent of the budget, or one-seventh of the French equipment budget evaluated on the same basis.

A historical compromise to reduce the budget deficit, which currently amounts to SKr56 billion per annum, was recently concluded with the social-democratic opposition. The defense budget is slated to undergo a cut of SKr3.6 billion for the current period (1992-1997) and a cut of SKr6 billion for the 1997-2002 period. In theory, this cut should be borne primarily by the operating budget, without affecting current programs; it appears, however, that this will be difficult to achieve.

The effort devoted to (military) defense—equal to 2.4 percent of GDP until last year—should thus experience a decline (in France, 3.5 percent for 1991, also on the decline).

Sweden's Key Figures Compared to France's (by convention, taken as equal to one)

	Sweden	France
Population	0.15	1
GDP	0.20	1
Defense budget	0.17	1
Equipment budget	0.13	1
Defense industry	0.18	1
Defense exports	0.24	1

Armaments Policy

The major components of Swedish armaments policy can be summarized as follows:

Procurement:

- Search for the most economical suppliers, according to regulations, with the possibility of deviating for political or military reasons, or for reasons of local employment in order to maintain a national industry.
- Pursuit of technological and industrial cooperation in conjunction with major procurement of foreign equipment, so as to benefit from exchanges of expertise.
- Development of arms flows with IEPG member countries.

Export:

- Strict governmental control; prohibition against developing equipment specifically for export. Strict limitation, based on neutrality policy, of the list of authorized export-recipient countries.
- A recent draft export bill seeks to establish clearer and, at the same time, more flexible rules, especially on restrictions against reexport, so as to hinder development of new cooperative efforts as little as possible.

Industrial policy:

In view of the independent national policy, the government bases its industrial policy for defense on the following principles:

- Need for reliable sources of supply and for in-country technical capability in sensitive areas.
- Maintenance and development of prime contractor capability for weapon systems adapted to the Swedish environment.
- Development of capability in various technical defense-related fields (ammunition, electronic systems, etc.).

Respect for these principles requires a strong defense industry. Because of the narrow domestic market, this entails a certain emphasis on exports as well as technological and industrial cooperation with foreign entities.

The latter aspect constitutes a government priority because it is the key to maintaining a viable industrial defense base.

In addition, this year the government committed itself to a program of privatization of firms in the vast public sector, with the intention of making them more dynamic and of accelerating the opening of the Swedish economy internationally. These privatizations may affect state-run defense industries; in that case, however, strategic considerations may predominate.

Defense Industry

General Industry Characteristics

Combining all sectors, the top Swedish industrial firms are:

- Electrolux, Europe's fifth-ranked manufacturer of electric and electronic equipment;
- Volvo, Europe's 11th (1991) manufacturer of transport equipment;
- Stora, Europe's top wood and paper firm.

Further down the list, there are Tetra Pak Alfa Laval (packaging, machinery), Ericsson (electric and electronic equipment), Procordia (agro-food), Svenska Cellulosa (wood and paper), and Saab-Scania (transport equipment).

There is defense activity in three of these groups (Volvo, Ericsson, and Saab-Scania); it accounts, however, for only a small proportion of their total volume of business.

Based on available information, Swedish defense industry is reported to (1990 Swedish and French figures):

- Directly employ about 45,000 people (versus 248,000 in France);
- Have an annual turnover on the order of SKr25 billion or Fr23 billion (versus Fr124 billion in France);
- Export 45 percent of its production (versus 31 percent in France);
- Satisfy by direct procurement approximately 85 percent of domestic requirements (versus 95 percent in France).

Swedish defense industry is spread over close to 2,000 firms (prime contractors and subcontractors), which are generally small in size (compared with equivalent companies in major European countries), but are often associated into large groups.

Swedish defense industry is based in the main on three pillars:

1. State sector: (approximately half of total activity) primarily assembled around the industry's new leader—the Celsius Industries group. This group, which started with the Kockums and Karlskronavarvet shipyards, now includes an aeronautical branch (FFV Aerotech), a land

weapons branch (Bofors), and an electronic branch (Telub). Beyond the Celsius group, the state sector also includes the NobelTech electronics subsidiary, the last vestige of the military activities of the Nobel Industries group;

*2. **Private sector:*** comprises the firms controlled by the Wallenberg family (approximately 35 percent of total activity): Saab-Scania, Ericsson, Incentive (which groups together the Haegglunds and Barracuda land weapons firms).

*3. **Also in the private sector:*** the Volvo group (approximately 5 percent of total activity).

[Box, p 119]

Celsius Industries

The Celsius group, now active in various defense sectors, employed 14,500 people (including 3,000 in the naval sector) at the end of 1991. It had a 1991 turnover of SKr11.1 billion (Fr10.3 billion), approximately 60 percent of which was for defense activity.

Of this figure, the naval sector portion was SKr2.7 billion (Fr2.5 billion), or 25 percent. Celsius, with total ownership of Bofors as of 1992 (50 percent ownership in 1991), is also active in the naval sector through the Bofors subsidiary Underwater Systems (torpedoes and unmanned submarines).

Celsius's ambition, now coming to pass, is to be the center of the Swedish defense industry.

The group's contemplated, at least partial, privatization could be the occasion of an opening to foreign partners. [end box]

Finally, it should be noted that the Swedish defense industry is active in the majority of armament sectors—with the exception of helicopters and, of course, the nuclear sector—up to and including the prime contractor level.

Sweden's Defense Industry (1991 data in billion ECUs[1]

Naval shipbuilding	Celsius	ECU1.5 billion
	SA Marine	0
Defense electronics	Ericsson	ECU6.1 billion
	Nobel	ECU3.3 billion
Artillery	Incentive	ECU1.8 billion
	Swedish Ordnance (renamed Bofors since 1992)	ECU0.6 billion
Military aviation	Volvo	ECU10.4 billion
	Saab-Scania	ECU3.9 billion

1 ECU = SKr7.47

Swedish defense industry (1990 figures): activity = ECU3.3 billion; employment: 45,000 people; percentage exported: 40 percent

Sweden's Defense Industry (1991 financial data unless otherwise indicated)

Company	Turnover			Personnel	Shareholders as of 1 July 92
	Amount (million SKr)	Defense Activities	Defense Amount (million SKr)		
Bofors (Swedish Ordnance in 1991)	4,500	100%	4,500	6,300	Celsius (100%) = State
Celsius (incl. 50% of Swedish Ordnance)	11,000	60%	6,600	14,500	State (100%)
Ericsson	45,800	5%	2,290	71,200	Svenska Handelsbanken (43%); Wallenberg (42%)
Nobel	24,700	8%	1,900	22,900	Nordbanken (70%) = State
Incentive	13,800	10%	1,380	15,100	Wallenberg (40%)
Saab-Scania	29,300	11%	3,220	29,300	Investor (100%) = Wallenberg
Volvo Group including Volvo Flygmotor	77,400	2%	1,550	63,600	Financiers (Skanska)
	3,700	38%	1,420	4,400	Volvo (100%)

Naval Ship Construction

After the disappearance of merchant vessel shipyard activity, there remain only three naval shipyards belonging to the Celsius group:

- Kockums, located in Malmoe, specializing in submarine construction and associated technology;
- Karlskronavarvet, located in Karlskrona, specializing in surface ships (coastal corvettes, mine chasers/sweeps, etc.) and maintenance/repair;
- Goetaverken Cityvarvet, located in Goteborg and in Landskrona, specializing in repair.

The Kockums group has had full ownership of Karlskronavarvet since 1990, and holds 50 percent of the

Australian Submarine Corporation (ASC) shipyards, which are supplying a portion of the six submarines ordered by Australia.

To this sector should be added:

- Scania Trucks and Buses Division of the Saab-Scania group, for its naval engine activity (Patrol Boat 90 program);
- NobelTech Systems subsidiary of the Nobel group (naval C^2 Systems);
- The small company SA Marine (mines and antimine warfare).

Civilian and Military Aerospace Industry

The aerospace industry, quite substantial compared to the size of the country, has a turnover on the order of SKr15 billion (Fr14 billion, versus close to Fr100 billion in France). It is composed mainly of: an airframe manufacturer (Saab Aircraft Division of the Saab-Scania group); an aircraft engine manufacturer (Volvo Flygmotor); aircraft equipment firms (the Ericsson group, Saab Instruments subsidiary of the Saab-Scania Group, Saab Ericsson Space joint venture, and Nobel's subsidiary NobelTech Electronics); two missile manufacturers (the Saab Missiles subsidiary of the Saab-Scania group and Bofors); and a maintenance specialist (the FFV Aerotech subsidiary of the Celsius group).

Volvo Flygmotor

The aircraft engine manufacturer Volvo Flygmotor, based in Trollhaettan, is part of the Volvo automobile group, of which it represents approximately 5 percent. It employed 4,000 people at the end of 1991 and had a turnover of SKr3.7 billion (Fr3.4 billion), 84 percent of which was in the aerospace sector.

The firm manufactures engines for combat aircraft under U.S. license, while improving and adapting certain components. It participates to a minor extent in programs for civilian aircraft and spacecraft engines.

In addition, the firm holds 90 percent (51 percent in 1991) of Volvo Aero Support, a joint venture with FFV Aerotech for military aircraft engine maintenance.

Ericsson and NobelTech: (See "Defense Electronics" below.)

Bofors: (See "Land Vehicles, Ammunition, and Explosives" below.)

Bofors's missiles division makes the BILL antitank missile and the RBS-70 and RBS-90 anti-aircraft missiles. It is developing the BAMSE anti-aircraft weapon in cooperation with Ericsson Radar Electronics.

FFV Aerotech

FFV Aerotech, based at Arboga, has been part of the Celsius group since the takeover of the FFV group in 1991. It constitutes the major portion of the Celsius group's aircraft support activity. FFV Aerotech employed 2,500 people at the end of 1991 and had a turnover of SKr1.8 billion (Fr1.7 billion), or 16 percent of the group's total turnover.

The future of Swedish aeronautical manufacturing is more tied to the success of the Gripen program (a fighter aircraft developed by the IG-JAS consortium, in which Saab-Scania, Volvo Flygmotor, Ericsson Radar Electronics, and FFV Aerotech participate), then to that of the Saab 2000 regional transport aircraft, produced with European partners, but in a fairly overcrowded market. The future of the missile sector rests on the development of the BAMSE missile.

Land Vehicles, Ammunition, and Explosives

This industry, whose turnover is close to SKr10 billion, is dependent in large measure on exports.

It currently is organized around two major players. Bofors covers all activities of the sector with the exception of those covered by the other. The second player, Haegglunds Vehicle (armored chassis, all-terrain vehicles), belongs to the Incentive industrial group (Wallenberg family), as does Barracuda Technologies (specialized in camouflage systems and polymers).

Bofors

The new Bofors company, based in Karlskoga, is a product of the merger early in 1991 between the former Bofors firm of the Nobel group stripped of its electronics subsidiaries, and the FFV Ordnance member of the publicly-held FFV group. Initially dubbed "Swedish Ordnance," it adopted the well-known name of Bofors in 1992, following the Celsius group takeover of the interest still held by Nobel. This takeover followed that of the FFV group by Celsius in 1991.

Bofors, which employed 6,300 people at the end of 1991, had a 1991 turnover of SKr4.5 billion (Fr4.2 billion), based entirely on military business.

The range of activities includes weapon systems (the turret for the CV90 combat vehicle, the chassis for which is made by Haegglunds; the STRIX terminal-guidance antitank mortar, produced in cooperation with Saab Missiles; the AT4 rocket launcher; mines; 40-mm guns; missiles; submarine systems; small calibers (arms and ammunition); and explosives).

Bofors is associated with Intertechnique and GIAT Industries for the BONUS cooperative project. BONUS is an antitank projectile that uses smart submunitions and is intended to satisfy Swedish and French requirements.

Incentive

The Incentive group, formed in 1991 by a split within the ASEA group controlled by the Wallenberg family, employed 15,000 people at the end of 1991. It had a turnover of SKr13.8 billion (Fr12.8 billion) in 1991.

The group's military activity is carried out through its subsidiaries Haegglunds Vehicle based in Oernskoeldsvik (turnover of SKr1.18 billion, about Fr1.1 billion) and Barracuda Technologies based in Laholm

(SKr 0.357 billion or Fr0.3 billion). Military activity represents on the order of 10 percent of the group's total turnover. Haegglunds Vehicle is developing the CV90 in cooperation with Bofors through the HB Utveckling joint enterprise, held by the two firms on a 75:25 percent basis. The company also produces the BV206 all-terrain tracked vehicle and plans to cooperate with GIAT Industries on various products.

In this section, mention should also be made of Scania Trucks and Buses Division of the Saab-Scania group and Volvo Truck Division of the Volvo group, both suppliers of trucks, engines and transmissions.

Defense Electronics

Three major groups—Ericsson, Nobel, and Saab-Scania—share the bulk of this sector, which represents a turnover of about SKr5 billion.

Ericsson

An electronics giant with a 1991 staff of 71,200 and a 1991 turnover of SKr45.8 billion (Fr42.6 billion), Ericsson's defense business represents approximately 5 percent of its turnover and is centered in the following subsidiaries:

- Ericsson Radar Electronics (predominantly defense activity), based in Moelndal: radars, countermeasures, avionics;
- Ericsson Radio Systems (minor involvement in defense activity), based in Stockholm: radio communications.

Ericsson is developing the radar for the Gripen fighter aircraft and the Erieye radar for advanced surveillance aircraft.

Nobel Industries

Nobel Industries is a diversified group (chemicals, biotechnology, electronics) which in 1991 employed 22,900 people. It had a turnover of SKr24.7 billion (Fr23 billion) with 8 percent attributable to defense activity.

Nobel Industries is 70 percent controlled by the publicly-held bank, Nord-Banken.

Defense activity is pursued in the Jaerfaella-based subsidiary NobelTech, whose activity is almost exclusively defense.

NobelTech, which combines the former electronics subsidiaries of Bofors (not integrated with Swedish Ordnance at the start of 1991), has two major subsidiaries:

- NobelTech Systems, formerly Bofors Electronics, held 80 percent by NobelTech and 20 percent by Ericsson: C^3I [communications, command, control, and intelligence] systems;
- NobelTech Electronics, 100 percent NobelTech, which as of the start of the year has taken over the activities of Bofors Aeronautics and SA Tech Electronics (avionics, telecommunications, ammunition electronics, optics), and the electronic warfare activities of NobelTech Systems.

NobelTech employed 2,300 people and had a turnover of SKr1.9 billion (Fr1.75 billion) in 1991.

Saab-Scania

Saab-Scania is active in defense electronics through certain subsidiaries of the Saab-Scania Combitech division:

- Saab Instruments (detection, stabilization, and sighting systems);
- Saab Training Systems (simulators, drones).

To this section, one should add the service company Telub (military communications, electronic supplies, etc.), which has belonged to the Celsius group since the 1992 takeover of the FFV group, representing 7 percent of the group's turnover.

[Box, p 120]

Saab-Scania

The Saab-Scania group, which employs 29,300 people, had a 1991 turnover of SKr29.3 billion (Fr27.2 billion), of which 24 percent was in aerospace and armaments activities.

In the aerospace field, it includes:

—The Saab Aircraft Division, based in Linkoeping, which acts as prime contractor for fighter aircraft programs (development of the Gripen JAS39 and maintenance/modification of the Draken and Viggen) and for regional transport aircraft programs (Saab 340 and Saab 2000), and produces equipment for the McDonnell Douglas MD-80.

—The Saab-Scania Combitech Division and subsidiary, based in Joenkoeping, which acts through its subsidiaries:

- Saab Missiles (RBS 15 antiship missile);

Saab Instruments (sighting systems and aircraft and missile equipment);

Saab Ericsson Space (space products), owned 60 percent by the group and recently merged by Saab Space with Ericsson Radar Electronics space activities.

[end box]

Conclusion

This portrait of the Swedish defense industry reveals:

- Its characteristics of quasi-completeness and absence of redundancy;
- Its being fully controlled by Swedish interests and by the state (50 percent);
- Its being increasingly dominated by the major player, the Celsius group, active in all four sectors.

The industry also involves other groups, known abroad, but for a minor portion of their turnover. Its overall size is far from negligible in Western Europe, since it ranks just behind its French, British, German, and Italian counterparts.

In conclusion, one can surmise that the Swedish defense industry, after having benefited from Sweden's independence and neutrality policy, and after having already undergone certain internal restructuring, will undergo further restructuring and will develop its ties with European partners to ensure its future.

French Government Restructures Defense Industry

93BR0379 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 21 Jan 93 p 10

[Article signed F.F.: "Defense Industry Restructuring Under Way"]

[Text] Closer cooperation between Dassault and Aerospatiale, and impending restructuring in tactical missiles between Aerospatiale and Thomson-CSF: The French government has begun to reorganize the nation's defense industry.

Due to the decline of military budgets and export contracts, a decline likely to last and be accentuated by soaring R&D costs, the French armament industry has no choice but to "shake up" the way it has been operating. Forearmed with this argument and bolstered by the sale of 60 Mirage fighters to Taiwan, the Ministry of Defense has managed to convince the sector's leading manufacturers that the industry needs to be restructured.

The first stage was the mid-December signing of a cooperation agreement between the presidents of Aerospatiale and Dassault, the objective being, among other things, to avoid duplicating R&D costs. The agreement provides for the creation of a strategic committee charged with the development of potential synergies in the fields of R&D, subcontracting, suppliers, strategy, and commercial policy. This cooperation between the two French aircraft makers has been sealed through the appointment of Aerospatiale President Louis Gallois as president of SOGEPA—managing body of the French State's aeronautics bonds. Through the transfer of part of the government's share, SOGEPA, whose new vice-president is Serge Dassault, now directly holds 36 percent of Dassault Aviation's equity. Louis Gallois will, thus, represent SOGEPA on Dassault Aviation's board of directors, while Serge Dassault will be doing the same on Aerospatiale's board.

Matra Hostile To Thomson-CSF/Aerospatiale Working Together

The other agreement envisioned in the field of tactical missiles will likely be a more delicate matter, affecting two out of three French missile makers—if Thomson-CSF can be considered one, because Alain Gomez's company does not manufacture missiles, as Matra and Aerospatiale are quick to point out. The cooperation between Aerospatiale's and Thomson-CSF's missile operations, which is currently being prepared, could be a joint-venture similar to Sextant Avionique, the flight electronics manufacturer jointly operated by Aerospatiale and Thomson-CSF. Their decision was prompted by a drop of orders in this field, where each is worth about 5 billion French francs [Fr] in turnover, with orders of Fr4 billion for Aerospatiale and Fr7 billion for Thomson-CSF.

Matra-Defense (Fr5 billion turnover for its missile operations) opposes the scheme, which it says it will not join unless granted a controlling share, because its Fr12 billion in missile orders gives it precedence over the other two. The matter gets even more complicated as, prior to any agreement with Aerospatiale, Thomson-CSF would like the French government to give it the green light on buying the missile operations of Irish company Short Brothers, so as to acquire the manufacturing dimension it currently lacks. Opponents to this arrangement say that should there be a change of government next March, Alain Gomez would feel no compulsion to honor his French commitments after taking over the Irish manufacturer's missile activities. So far, equipment builders seem to escape the reshuffle the rest of the French defense industry has been undergoing. The 8 percent interest in Dassault Electronique taken in mid-October by SAGEM [General Electrical and Mechanical Engineering Company] is thus perceived as a way to keep Alain Gomez at bay rather than the first ripple of a sector-wide restructuring.

ENERGY, ENVIRONMENT

Germany: Fraunhofer Institute Develops Environmental Pollutant Sensor

93WS0223C Duesseldorf VDI NACHRICHTEN in German 4 Dec 92 p 29

[Text]

Sensor Detects Pollutants

Gel on Glass As a Principle of Measurement

Susceptibility to corrosion is not always a bad thing—corrosion-induced chemical changes can also be used to make measurements. A glass sensor developed by the Fraunhofer Institute for Silicate Research, Wuerzburg, reacts like a dosimeter to environmental aggressivity. The sensor detects not only individual pollutant parameters, but also the overall effect.

The glass surfaces, measuring only a few square centimeters, are placed directly at the point of measurement and detect corrosion processes in the material like in time-lapse photography. Under the influence of humidity and acidic air pollutants such as sulfur dioxide and nitrogen oxide, a sort of gel forms on the glass surfaces. Potassium and calcium are leached out, and at the same time protons and water molecules are deposited. "The water

molecules can then simply be identified spectroscopically," explains glass researcher Dr. Dieter Fuchs of the Fraunhofer Institute, "and the progress of corrosion can be assessed."

At first the sensors were only planned as "environmental guardians" under protective external glass, for example to analyze the condition of historical glass paintings. It turned out, however, that they are more fully suited for environmental monitoring.

Now the sensors monitor the air in museums; at the Brandenburg Gate in Berlin, they will measure material pollution at various sites in the structure in order to come up with specific protective measures at an early stage based on the results. Fuchs was recently awarded the 1992 Joseph von Fraunhofer Prize for the development of the sensors.

Germany: Geosciences R&D Center Develops Advanced Equipment for Marine Research

93MI0301 Bonn DIE WELT in German 28 Jan 93 p 9

[Article by Rolf H. Latusseck: "New Measuring Instruments for Marine Research"]

[Text] The Marine Geosciences Center (Geomar) at Kiel presented new marine research equipment this week. Glass has proved a suitable material for use at depths of up to 4,000 meters: Compared with steel, it has the advantage of not rusting, and of admitting electromagnetic signals, including light, so a new instrument case made of glass makes it possible to transport photographic and video cameras, which can receive measuring and control signals without hindrance.

Marine research is particularly dependent on technical equipment that takes measurements and gathers data and samples in, on, and under water for prolonged periods on behalf of human researchers. Flow measurement plays a major part, whether near the surface or on the ocean floor.

Water motion of this type was previously measured using rotating propellers, but an acoustic flow meter has now been developed. Special loudspeakers transmit a sound signal, which is reflected by an acoustic mirror and picked up by a special microphone. As the sound waves are carried by the flowing water, the reflected signals hit the receiver at different points: The greater the flow rate, the greater the divergence from zero. The flow speed can be calculated from this divergence.

Several devices are mounted closely together on a support frame for the fullest possible all-round data acquisition. The "bioprobe" is a multicomponent system of this type, also featuring a bottom water sample scoop.

In order to be able to perform immediate, precise sample analyses on board, Geomar has developed a balance that compensates for the ship's motion. This "rough-sea compensating on-board balance," which can be set for seas up to force six, can be used to weigh samples to the nearest milligram.

German Mathematics, EDP Society Runs Smog Analysis, Forecasting Project

93MI0328 Bonn WISSENSCHAFT WIRTSCHAFT POLITIK in German 13 Jan 93 p 4

[Text] A large-scale pilot experiment is currently being performed to find out whether parallel computers can be used to analyze and forecast the spread of atmospheric pollutants.

The simulation results obtained to date are being processed by the environment authority responsible for the Berlin area with a view to achieving what is termed in technical jargon "smog management."

The "dynamic smog analysis and forecasting models" project, which Professor Achim Sydow is leading at the Society for Mathematics and Data Processing (GMD, headquarters in St. Augustin) Institute of Computer Architecture and Software Engineering in Berlin, comprises several aspects.

Information on the topography of the territory concerned, the use to which the land is put, and the industrial, domestic heating fuel, and traffic distribution is stored in a database.

Grid Over the City

The wind, temperature, and humidity distribution and determined in a meteorological model with reference to grid points positioned over the area. This model is coupled to what is known as an air chemistry model, in which the mechanisms involved in the reactions between about 100 components are acted out. The interaction between the two models provides information as to the pollutant concentrations both before and after transport in the air, and "thick air" paths are predicted or traced.

The maps thus obtained with the territorial coordinates of the Greater Berlin area provide a precise picture of, for instance, the sulfur dioxide concentration in the lower air layers (from 0 to 50 m) and its probable "migration" through the city.

Mass of Data Requires Parallel Computers

From the outset, parallel processing strategies were central to the implementation of the simulation system in Berlin; indeed, Professor Sydow is responsible for research on applications for parallel computers. Many other organizations, from Parsytec GmbH of Aachen and Chemnitz to the Russian Academy of Sciences Physics Instute in Moscow are also involved.

Germany: Aachen Technical University, German Research Association Develop Process to Measure Steel Corrosion

93MI0340 Bonn DIE WELT in German 11 Feb 93 p 7

[Text] Scientists at the North-Rhine Westphalia College of Technology (RWTH) in Aachen, with support from the German Research Association (DFG), have developed a process for continuous steel corrosion monitoring. The measurement principle exploits the fact that iron ions are dissolved at the rusty points on the steel surface. This in turn releases electrons. These excess electrons react on the surrounding steel surface with oxygen and water, and the corrosion rate can thus be measured as electrical current.

A steel frame is normally embedded in a cement and sand mixture to protect it against corrosion. The cement keeps the moisture in the pores alkaline, but air can penetrate, and its carbon dioxide content can form an acid, whereupon the steel reacts with the moisture in the atmospheric oxygen and begins to rust. Salt spray and sea water can also attack concrete.

The concrete surround must be as large as possible if it is to prevent the concrete in buildings from cracking or even chipping. The scientists in Aachen also recommend that the concrete be slightly permeable to, and bond readily with, chlorine salts.

However, this requires a very low water to cement ratio. After extensive laboratory tests, sensors that monitor the corrosion hazard on a continuous basis, and can be embedded directly into the concrete in new buildings, have been developed.

FACTORY AUTOMATION, ROBOTICS

Germany: BMFT Funds CIM Technology Transfer Program

93MI0286 Bonn JOURNAL in German Dec 92 p 7

[Text] Companies wishing to introduce modern production technology rapidly and economically can now obtain yet more support in Bremen. The rebuilt Bremen Institute of Industrial Engineering and Applied Ergonomics (BIBA) at the University of Bremen represents a signigicant improvement in conditions for application developments, technology transfer, and quality testing.

In particular, BIBA is to support industry in the lower Weser region in the technological innovation process. In addition to a database service and CAD/CAM [computer-aided design/manufacturing] laboratory, it offers knowledge transfer for computer/integrated manufacturing (CIM). BIBA's main concern is to develop and implement CIM in on-off manufacturing and assembly, for instance in the construction of special-purpose machines, aircraft, or ships, rather than in series production. This makes it ideally suited to the industrial structure of the Bremen region.

Under its Manufacturing Engineering Program, the BMFT [Federal Ministry of Research and Technology] has provided 3.2 million German marks [DM] to fund the BIBA CIM Technology Transfer Center from 1988 to 1992. The initial idea was that financial support would accelerate the development of such centers, making them efficient and attractive. They will subsequently be supported by industry itself.

Implementation in industrial applications, especially in small and medium-sized enterprises, of the practical knowledge and experience gained from CIM research will then be sped up. Like the "lean production" concept, CIM aims to reduce throughput and warehousing times, and to provide flexibility and quality. Overall, the BMFT is funding CIM technology transfer centers in 21 locations, five of them in the new federal laender.

Italy: Laboratory Robot Developed for Diagnoses

93MI0313 Milan GENTE MONEY in Italian Feb 93 pp 88-89

[Article by Emilio Torredimare: "Their Robot Discovers Allergies"]

[Excerpts] How to make money from pollens, dust, animal hairs, wool, and serums, or in other words, from an army of allergies waiting to attack from common hay fever to skin rashes, from asthma to the highly dangerous anaphylactic shock. Bioallergy, a small company in Trieste, is trying to do just that and has had the courage to challenge the monopoly of a multinational Swedish giant. It is doing so with a secret weapon which has put the competition on the run and which everybody is trying to copy. ENEA [Efficient New Enzymatic Allergy System] is a mini-robot, the only machine in the world to completely automate test-tube dosages for the laboratory diagnosis of allergies.

The fact is that probably nobody is completely immune from allergies and so the number of subjects involved makes this a very profitable business. Therefore, any company which is able to corner the diagnostic market for the determination of the cause of an allergy can count on a large-scale worldwide business.

Up until 1989, that privilege was locked up in the patents office of Kabi-Pharmacia, a company belonging to the Swedish multinational Procordia, which has held the sole rights for 20 years. Now, two small-timers, Simonetta Cosimi and Nevio Recinelli—both vice presidents of their company Bioallergy International—are challenging the ex-giant through the placing of one ENEA after another: in 70 out of the 250 hospitals in Italy which have allergy departments, 35 percent of the analytical laboratory market. In addition, the first aggressive moves away from home have also been made in Spain, France, and Germany, and even as far as the Swedish wolf's den: The hospital at Upsala, the city where Kabi-Pharmacia has its headquarters which, while continuing to use the company's system, has asked to take an ENEA on trial.

ENEA's Beginnings

Everything started at the beginning of 1987 in the offices of Importex Pharmaceutical Chemists in Trieste, a company affiliated with Don Baxter Laboratories, the American pharmaceutical collosus. Nevio Recinelli had gained all his experience there, working for the group for more than 19 years and at the time he was sales director. Simonetta Cosimi, instead, was a young researcher who had finished university four years before and had come to work as a product manager in the diagnostics division. In other words, she knew all the technical secrets of allergology. [passage omitted]

In February 1987, these two decided to go into business on their own and months of hard work resulted in the creation of their company, Bioallergy, by the end of the year. To start with, it was merely a commercial concern doing the same thing as Don Baxter, that is, distributing material for allergy diagnosis. [passage omitted]

A 600-Million-Lire Investment

In the meantime, with Bioallergy serving as the basis for getting started, making money, and creating a structure, the main project for a machine which could do everything went ahead. Between the end of 1989 and the beginning of 1990, the business plan was ready. Principally, the designers had put together the first prototype of the automated diagnostic system together with the specific reagents which it would use. The total cost of the project was around 600 million lire. Results were immediately outstanding. Without the presence of an operator, the machine was able to carry out 450 tests for 30 patients in four hours, against the 180 tests for 30 patients in the six and a half hours of a nonautomated system. For a big hospital, that meant testing at least 60 patients a day, or even more, seeing that the machine can work unsupervised at night, and print out the results the next morning. What is more the tests performed were 10 times more precise than traditional tests.

At that point, everything was ready. All that was needed was a name for the machine and headquarters that would not be too expensive for the company's meagre resources. Since the mother company Bioallergy was based at Fiumicino in the so-called Isola Sacra area, the place where ENEA is said to have landed, the name had to be that of the Trojan hero. All that then needed to be done, was to invent an acronym to fit the name ENEA. No sooner said than done, and Efficient New Enzymatic Allergy System was coined. The major difficulty, however, was finding a suitable structure in which to establish the new company, Bioallergy International, which would produce the reagents and manage the ENEA patent.

Return to Trieste

The mountain which seemed unsurmountable was finally overcome with the help of the BIC (Business Innovation Center) of Trieste, a public organization for the promotion of technological enterprise. "Without BIC in fact," says Simonetta Cosimi, "we would never have been able to put the idea into operation. And for me there was also a personal factor involved, which was the opportunity to return to Trieste, my home town." At BIC, Bioallergy International found everything it needed to function: well-equipped areas, consultants, training, conference rooms, telephones and telefaxes, and assistance in finding financial backing. As a result, from December 1989 the new company was able to begin producing diagnostic materials exclusively for ENEA, which were then marketed by Bioallergy, the mother company in Rome. At present, the diagnostic robot is produced under license exclusively for Bioallergy International by an outside company but soon many ENEAs will be built by the company itself at its factory in Trieste.

This Friuli-based company, whose revenues came to 500 million lire in 1991, quadrupled its business by the end of 1992 to 2 billion lire. The forecasts predict a rapid growth: 6 billion lire for 1993 and 10 billion lire for the following year when the Bioallergy group should reach revenues of 28 billion lire with an expected profit of between 15 to 18 percent. In reality, the profits do not come from ENEA, a machine which costs 60 million lire and is lent free of charge to hospitals, but from the reagents which are necessary for its operation.

The prospect of an enticing world market has opened up for Bioallergy. "The new projects will not stop with ENEA," say the two vice presidents. "We are already planning a robot which will be even more versatile and innovative."

MICROELECTRONICS

German Company To Build Testline for JESSI Flexible Automation Wafer Production Plant

93WS0223B Duesseldorf VDI NACHRICHTEN in German 4 Dec 92 p 22

[Text]

JESSI Project Faces Practical Test

Flexible Wafer Manufacturing in the Chip Factory

Small Batch Sizes Become Economical

Application-specific integrated circuits are a submarket of microelectronics in which European manufacturers think they have good prospects for the future. But small batch sizes in the manufacturing of ASICs lead to changing demands on the production line. Short set-up times, high yields, and high quality are crucial criteria for profitability. Whether or not they can be met will depend essentially on the degree to which flexible production tools can be developed.

The main idea of flexible ASIC manufacturing is "Integrated Sequential Wafer Processing," in which computer-controlled conveyor belts and robot manipulators

are linked with IC process technologies for assembly line chip production. This requires multifunctional and flexible tools which, on the one hand, have standardized mechanical interfaces for the automatic wafer delivery and, on the other hand, are equipped with software interfaces for data exchange with the process-monitoring computers of manufacturing control.

More than 30 European firms and institutes have committed themselves to the realization of this concept with the project "Flexible Automation Wafer Production" (FAW) within the framework of the Joint European Submicron Silicon Initiative (JESSI). "The goal of FAW is not completely automated mass production, but rather flexible automation which makes it possible to produce ASICs profitably with different manufacturing techniques even in small quantities," emphasizes Hartmut Weule, research director of Daimler-Benz AG. The Stuttgart technology group is involved in the FAW project as project director and plans to build an FAW test line as a "bypass" parallel to a regular production line at the Daimler subsidiary "Telefunken Microelectronic GmbH" (Temic).

This test platform, for which the clean rooms have already been completed, is a subproject of the overall FAW project. It will be made available in conjunction with the six-inch line presently under construction at Temic and will aid in the integration of new devices to be developed in other subprojects in an automated manufacturing environment. "The goal," explains Temic's Frank Stephany, who is responsible for project coordination, "is to test new devices and equipment under actual production conditions in order to be able to say something about dwell times and process qualification."

"The CIM hierarchy is an essential point," emphasizes Stephany. It involves central data acquisition, control, and optimization of all the individual processes important for production. This includes development of central electronic identification techniques (wafer tracking), global monitoring and control of important process parameters such as temperature, cleanliness, humidity, and, especially, functionality and compatibility of individual devices for the entire interlinked process.

The interlinkage itself is provided by a rail transport system, which is being developed under the direction of the firm Meissner + Wurst GmbH, Stuttgart. The two central elements of the logistics are an automatic material storage area and so-called SMIF boxes (Standard Mechanical InterFace), in which the wafers are transported and temporarily stored and which at the same time guarantee the ultraclean environment of the silicon slices on their way through the process line.

Here, as in the individual processing steps, a local clean room concept is used in which the processing zones are rigorously separated from the operators and the environment. Limitation to the immediate wafer environment leads not only to savings in the design of the most sensitive clean room zones, but also simplifies working conditions of the employees if their present clothing regulations, reminiscent of astronauts, can be relaxed.

The clean room requirements are especially strict in lithography, because defects resulting from particulate impurities unavoidably continue into the subsequent steps of the IC manufacturing process. Limiting the influence of humans as a disruptive factor in chip production is a goal of the subproject ALC (ASIC Lithography Cluster). Under the direction of Convac GmbH, Wiernsheim and Dresden, its object is the development of a modularly constructed lithography device in which inspection of the wafers for line width and registration, delivery of the wafers to the exposure equipment for structural mapping, and, finally, the finishing treatment of the slices will be integrated.

The tight coupling of statistical process control and on-line control of manufacturing is the goal of other subprojects in the FAW project. It should be possible to recognize deviations from the target parameters at the beginning so that they can be controlled before they affect the yield. That requires continual on-line and in-situ analysis of the semiconductor layers, up to 15 of which are grown on a slice in a modern CMOS circuit. The development of a fast, automated ellipsometer is on the program, with which defects can be detected using changes in the phase and polarization of light reflected from the surface of the deposited layers.

Visual testing methods also await automatization in order to increase the accuracy and speed of defect analysis. With this end in view, Jenoptik GmbH, Jena, is working in Project Abiko (Automatic Image Control) on the development of a new generation of defect control devices which automatically search photolithographic masks and epitaxial layers for defects.

The JESSI initiative's FAW project is an attempt to consolidate European microelectronics in the area of ASICs. "We must remain competitive on a global scale in their design, but we must also be able to produce them cost-effectively and have them available at any time," says Hartmut Weule, outlining the strategic objective. The user's concern about becoming dependent on non-European suppliers, which may possibly be closely linked with competing users, is great. "Even an increasing dependence of the 'second type'—on the equipment and process level—would endanger Europe's competitiveness."

Survey on Germany's Position in Microelectronics

93WS0240A Duesseldorf HANDELSBLATT in German 20 Jan 93 p 21

["Microelectronics Capability a Matter of Concern"]

[Text] *HANDELSBLATT, 19 Jan 93 BERLIN*—The Association of German Electrical Engineers (VDE) is seeking a concerted effort to promote key technologies. The results of a new study indicate that increased concern is spreading among VDE member organizations

about Germany being able to retain its international standing and competitive ability in the face of internationally accelerated technological change.

In its study, the VDE, which celebrates its 100th anniversary in Berlin tomorrow, points especially to the pessimistic evaluations of those queried concerning the state of the microelectronics industry. Some 67 percent of the 150 participating companies fear that Germany either already has, or soon will miss the boat with regard to being a world class microelectronics producer. In the survey 95 percent ranked Japan the clear leader in the high-tech field, followed by the United States (75 percent), and Germany (68 percent). France with 35 percent, Great Britain and the CIS each with only 5 percent trailed Germany.

The VDE believes that in 1993 almost every second chip will have been produced in Japan. At the same time, the Association is forecasting a continually increasing total consumption of microelectronics component parts from 5.2 billion German marks [DM] in 1991 to DM11.5 billion in the year 2000.

The study, prepared on contract by the Sample Institute for Market Research, showed that managers were not satisfied with German society's indifferent acceptance of the new technologies. Public opinion on the matter runs from indifferent to negative. Also lamented was the insufficient amount of basic research performed (62 percent) in the field as well as Germany's slow, even late, transition over to new technologies.

The VDE strongly recommends that concerted action by the government, the economy, science, and professional associations be concentrated on telecommunications, automation, environmental concerns, medicine, and transportation. As compared with other large industrial regions, Europe has produced too few innovations. VDE chairman Arno Treptow is therefore calling for a "long overdue technological/political dialogue at the European level."

Germany: Bosch To Build Advanced Semiconductors Factory in Reutlingen

93MI0333 Munich SUEDDEUTSCHE ZEITUNG in German 10 Feb 93

[Text] The Stuttgart-based Robert Bosch GmbH will invest approximately 200 million German marks [DM] by 1996 in the construction of a new semiconductor factory in Reutlingen. As the company reported, this factory will be located in a new building and will focus on the production of six-inch wafers which will gradually replace the four-inch ones currently manufactured.

Starting mid-1995, Bosch will introduce a round-the-clock manufacturing process, that is 24 hours a day, seven days a week. To achieve this goal, approximately 300 people will be employed on a free-lance basis. The company's board of directors and the local factory committee have already come to an agreement on the regulations.

Bosch has produced application-specific integrated circuits and semiconductors in Reutlingen since 1971, primarily for its own use. The premises also host the company's Microelectronics Technical Center in which electronic components are designed and developed. Approximately 700 out of over 5,600 Bosch employees work in the sector of semiconductors, while the remainder are employed in the fields of electronic control equipment and optical engineering.

Germany: Method To Improve Chip Design Developed at Bonn University

93MI0337 Munich SUEDDEUTSCHE ZEITUNG in German 11 Feb 93 p 37

[Text] Researchers at Bonn University's Institute of Discrete Mathematics have developed a microprocessor comprising three and a half million transistors. The mathematicians' achievement lies, however, less in the integration of the large number of components than in their optimum placement and wiring on the chip.

Chip producers have in fact encountered the following problem with such complex processors: The single components, for instance memory cells, must all receive the clock pulse at the same time, tolerating only a very slight deviation of a few picoseconds (millionths of a second). By way of comparison, light takes one picosecond to travel across the diameter of a human hair.

The scientists have now used mathematical methods to optimize various parameters such as the length, resistance, and capacitance of the connecting wires, a task that quickly becomes more difficult as the number of transistors and the clock speed increase. With simple systems, heuristic methods are generally used, in other words the researcher feels his way towards as good as possible a solution, which may, however, not necessarily be the best one. This is where discrete mathematical methods come in: The scientist attempts to comprehend the chip structures and simulate them in a mathematical model from which he derives a formula that solves the problem.

Goals, Participants of New ESPRIT Microwave IC Projects Noted

93BR0369 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 14 Jan 93 p 23

[Article signed J.-C. G: "Microwave Technology Wins with European Strategic Program for Research and Development in Information Technologies (ESPRIT)]"

[Text] The establishment a few months ago of two microwave integrated circuit [IC] research projects, called MANPOWER (Manufacturable Power MMICs [monolithic microwave IC's] for Microwave Systems

Applications) and CLASSIC (Components for Large Signal 60 GHz GaAs [gallium arsenide] ICs), is a confirmation of the strong emphasis the European ESPRIT [European Strategic Program for Research and Development in Information Technologies] program places on microwave technology. There are now seven current ESPRIT projects in this field.

Now in its third phase, which began in April 1992, the European ESPRIT program has established two new 36-month microwave research projects respectively called MANPOWER and CLASSIC. The first one is coordinated by GEC Marconi Materials Technology (GMMT) and includes French participants Philips (LEP [Electronics and Applied Physics Laboratories]) and Dassault Electronique. It focuses on L-band (mobile telephone systems) power MMICs of the MESFET [metal semiconductor field effect transistor], HEMT [high-electron mobility transistor], and HBT [heterojunction bipolar transistor] types, up to 30 GHz. MANPOWER seems a fitting heir to the COSMIC project (GaAs Monolithic Analog Circuits for Microwave Communication Systems up to 23 GHz), whose completion date has been set for next December. COSMIC concentrated on small-signal, low-cost ICs used in commercial communications systems (DBS [direct broadcast satellite], GPS [general purpose satellite], wireless telephones, and high-speed optical communications).

PM-HFETs [Pseudomorphic Heterojunction Field Effect Transistors] Best Choice at 60 GHz

Coordinated by Daimler-Benz and including, on the French side, Thomson-CSF, Alcatel Espace, the University of Limoges, and the Technical and Scientific University of Lille, the CLASSIC project aims at developing a technology suited to nonlinear microwave components at 60 GHz (mixers, oscillators, and amplifiers in MMIC form) in applications such as vehicle-to-vehicle or beacon-to-vehicle mobile communications. Participants will concentrate on pseudomorphic heterojunction field effect transistors (PM-HFETs), a type of component considered as the most promising at such frequencies.

Other projects on microwave technology will continue in 1993, including MONOFAST (Monolithic Integration beyond 26.5 GHz), MORSE (Metal-Organic Research for Semiconductor Epitaxy), PLANET (Multiwafer Planetary MOVPE [metalorganic vapor-phase epitaxy] Reactor), and, above all, AIMS (Advanced Integrated Millimeter Wave Subassemblies), managed by Thomson-CSF. This last project's objective is to develop a range of millimeter components and subassemblies with a view to popularizing applications such as anticollision radars operating at frequencies of about 76 GHz. It makes use of the results of the now complete GIANTS (Advanced GaInAs-Based Devices for High-Speed ICs) project, through which Thomson-CSF showed, among other things, the feasibility of pseudomorphic HEMTs with 0.22-micron grid length and with a transition frequency in excess of 100 GHz.

Siemens Develops Fast Parallel Vector Processor

93BR0381 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 21 Jan 93 p 16

[Article by Elisabeth Feder: "Vector Processor Speeds Up Signal Processing 10 Times"]

[Text] Siemens has developed a vector processor that links four parallell operating modules and is capable of carrying out 800 million 16-bit multiplications per second. This is at least 10 times faster than the best that is currently possible in signal processing.

Siemens's Central Research and Development Division has designed a programmable vector processor suited for general signal processing applications and in particular for the simulation of formal neural networks. This circuit, designated MA16, features a computing capacity of 800 million 16x16-bit multiplications and fixed-decimal point additions per second at a clock frequency of 50 MHz. This is possible through the interconnection of four identical processing modules in the form of a single-instruction, multiple-data (SIMD) type configuration. The component, which comprises 610,000 transistors on a 187-mm^2 chip in 1-micron CMOS [complementary metal-oxide semiconductor] technology, is the most sophisticated logic integrated circuit implemented so far by the German group. The software needed for the development of applications will be available as of June and development boards for workstations and personal computers are also being prepared.

Four Parallel Data Signal Processors

The MA16's computing performance could be achieved through four identical modules, each functioning as a signal processor, that operate in parallel. The basic module comprises three main functional units: multiplication/addition unit, storage unit, and additional processing unit. The first unit consists of a systolic chain of four multipliers and adders that are capable of doing calculations on partial matrices (4x4 bits). The results of these calculations can either be stored in the storage unit to permit operations on larger matrices (or vectors), or sent immediately to the next module, where they are added to other intermediate results. The third unit carries out special operations, such as bit spacing, rounding off or cutting (values), handling overflows, "noise" superimposition due to a random generator, selection of a 16x16-bit window, transformation to floating-point format, double-accuracy calculation, or functions that are specific to neural networks. The special operations are either carried out on the intermediate results or on the results that are stored at the end of the chain. The MA16's microcode is integrated in an external ROM [read-only memory]. Inside the MA16, cascade interconnection of the four basic modules results in an SIMD-type network with a 48-bit storage path that runs through all the modules. These modules are controlled by the same signals (on 13 bits) that arrive on the control data port. A control memory of 16 six-bit words

that contains the configuration of operations to be carried out in each machine cycle is linked to each module. Configuration of one cycle is programmed during execution of the preceding cycle.

The component's performance is illustrated by application examples (where operations can be written in the form of algorithms), especially in image processing, such as image convolution to two dimensions, signal correlation, or image transformation to two dimensions. For instance, a system designed around an MA16 circuit can convolute a 512x512-bit two-dimensional image in 0.01 millisecond by means of a 16-bit window. A discrete cosine transformation takes 12 ms. For very complex systems, several MA16 circuits can be linked in cascade, with the overall performance increasing linearly with the number of circuits, as long as the various operations to be carried out can be done in parallel.

Optimized For Neuron Networks

Due to its architecture and programmability, the MA16 vector processor is particularly suited to neural network simulation. Various operations, such as multiplication/addition of matrices, are in fact present in all learning algorithms or neural models. Thus, a real-time sample recognition system with a fixed neural network has been developed experimentally on the basis of five MA16 processors. Siemens has also developed a neural computer whose design is based on a multiprocessor architecture around eight parallell operating MA16 processors, with DRAM [dynamic random access memory] memories having a total capacity of 128 Mb for storing weighting factors and two 68040 microprocessors for system control. This computer is called Synapse 1 and reaches a computing speed about 8,000 times faster than a SparcStation 2.

Tools designed for the MA16's development environment are being prepared. In particular, Siemens will initially (in June 1993) supply libraries containing the basic operations, a program that enables the user to configure the algorithm to be installed and to specify the input data. Later, Siemens will offer a library for complex operations and partial algorithms (for the frequently used matrix and/or vector calculations) in the form of macros, a simulation program, and a preprocessor for handling complex operations.

German Heraeus Produces Printed Circuits With 75-Micron Features

93BR0382 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 21 Jan 93 p 20

[Article signed L.M.: "Printed Circuits With 75-Micron Tracks Reach Mass Production Stage"]

[Text] The German company Heraeus's printed circuits with tracks and intertrack spaces of 75 micron are particularly suited to mass produce miniaturized systems.

The Germany company Heraeus's "Herastrat" printed circuits provide an interesting solution to very-small-sized systems, such as electronic systems for cameras, pocket calculators, or pacemakers. For these applications, Heraeus mass-produces very compact printed circuits in which the conducting tracks and interspaces are only 75-micron wide (compared with the 100 microns in conventional systems), i.e., a density of seven tracks per millimeter. These printed circuits are thus perfectly suited to chip-on-board technology, a technology which consists in bonding bare chips directly to the circuit tracks using extremely fine wires. This chip-on-board technology, which makes it possible to use chips without housing and thus to save space and weight, is one of the solutions chosen frequently by users in search of miniature electronic systems. It should be noted that there is growing demand in this field, and that other manufacturers of printed circuits, such as Ciretec and SPCI [Professional Printed Circuit Prototyping Company] of the CIRE [Printed Circuit and Electronic Developments] group are also interested in very dense circuits. However, Heraeus claims to be the only large-scale manufacturer of printed circuits with 75-micron tracks in the market. The other manufacturers are said to manage only small production runs. Heraeus claims that it can produce prototypes with features very much below 75 micron.

"Herastrat" printed circuits are manufactured from a copper-coated epoxy resin substrate. The 75-micron wide tracks are obtained by an improved etching system. Heraeus did not wish to provide more information on this process. Welding is normally done with gold or palladium, but the materials are generally chosen according to application and in consultation with the clients.

Belgium: IMEC Develops Highly Efficient Flash Chip

93BR0393 Rijswijk POLYTECHNISCH WEEKBLAD in Dutch 29 Jan 93 p 1

[Article by Rene Raaijmakers: "Memory Cell Off to a Brilliant Start—New Flash Chip Is Faster and More Energy-Efficiently Programmable Than Its Predecessors"]

[Excerpts] Leuven—The Interuniversity Microelectronics Center (IMEC) in the Belgian town of Leuven has made a breakthrough in the area of flash chips. These are reprogrammable integrated circuits (ICs) which, unlike ordinary memories, do not constantly use energy to retain data. With the Belgian chip, data can be rewritten 10,000 times faster than with other flash memories, yet it requires just a fraction of the power. This could have applications in portable computers, for example.

The briefing on the breakthrough has garnered many accolades for IMEC. Last month, Prof. H. Maes, who is the leader of IMEC's research group for non-volatile memories, brought a number of companies up-to-date

on the new developments in flash chips. "Exciting. We are very impressed," quotes Maes with relish from his office. Without batting an eye, he says: "I do not think that there is any better flash cell at this time."

IMEC researchers have invented a sophisticated way of writing and erasing data on flash memory cells more efficiently and faster. To do this, the Belgian researchers designed a new structure for the flash transistor, which is the basic element in non-volatile flash memory chips. [passage omitted]

Technological Brainteaser

The technological brainteaser revolves around the little silicon island [floating gate] in the flash memory cell. The main questions are: how do we get electrons onto it (write), and how do we get them back off (erase). "Writing" is comparable to throwing pebbles from the ground up to a 10th-floor apartment. Without some sort of trick, it cannot be done. The trick used by Intel and Toshiba in their flash memories is of a temporary nature. A substantial voltage is applied to the two poles of the flash transistor for a short period of time. An avalanche of so-called "hot electrons" is thus released, and of those, there are always some that tunnel their way through the silicon oxide to the floating gate. When erasing data, the electrons are sucked off the island with a powerful electrical field.

This method of writing is inefficient. In conventional flash cells, for example, those made by Intel, just one of 100,000 electrons make it to the floating gate. So there is still plenty of room for saving energy.

In the new HIMOS cell, IMEC's High Injection-Efficiency MOS [metal oxide semiconductor] transistor, practically all the electrons reach the floating gate due to the cell's sophisticated construction. This makes programming faster and saves energy. According to Maes, "Conventional flash memory chips need milliseconds; we program in tens of microseconds." That is a factor of 10,000.

There are other advantages, too. To write to a conventional flash memory chip requires high currents. This means that a voltage supply of at least 12 volts outside the chip is required. Since the HIMOS chips uses so little power, a current supply of 5 or 3.3 volts is enough to be able to program the chip.

Created using 0.7-micron technology, HIMOS cells cover a surface of some 15 square microns, compared to 10 square microns for ordinary flash chips. Maes expects that this can be improved. In pure memory cells, where each thousandth of a millimeter counts, 30 to 50 percent more surface area is a disadvantage.

Embedded Applications

According to Maes, the future of the HIMOS cell lies primarily in the so-called "embedded applications," in which HIMOS memory blocks can be part of other chips, such as ASICs [application-specific integrated circuits]. "It is estimated that within five years, one of every two ASICs will need this integrated memory, e.g., for identifying objects or for storing data about the effects of wear on the life-span of a product. Application-specific chips do not need large memories. Often, just a few kilobits are enough. But the success or failure of the product depends on them," says Maes.

New Building Blocks

HIMOS technology is fully compatible with CMOS [complementary metal oxide semiconductor] technology, which is used by many chips (including DRAMs [dynamic random access memories]). Although they are quite easy to apply in production processes, manufacturers and systems developers are not yet ready to integrate new building blocks into design software. Therefore, Maes thinks that HIMOS technology will primarily be picked up by enterprises which are on the verge of taking the step into the world of microelectronics.

Swiss Valtronic Develops Highly Compact Multichip Modules

93BR0398 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 28 Jan 93 p 18

[Article by Laurence Mizrahi: "Valtronic Stacks Chips and Does Away with Packaging"]

[Text] Through chip-on-board and FR4-substrate technology, Valtronic has been making very compact multichip modules (MCMs) that are cheaper than sophisticated MCMs. To save space, the Swiss firm also proposes to "stack" bare chips.

True to its "miniaturistic" calling, the Valtronic company is offering two efficient new technologies which ably meet electronic system user concerns with respect to space optimization, especially in answer to the question: How can one increase component integration on a board using as inexpensive a substrate as possible? Valtronic first proposes using a piggyback technology, or "chip-on-board" (direct mounting of a chip on a substrate), which is one of its specialities, to achieve unpackaged—and consequently more compact—multichips. Valtronic also proposes to save space by stacking chips vertically, since headroom is more readily available.

The first "unpackaged" technology uses an FR4 substrate or an FR4 derivative can withstand higher temperatures. Chips are mounted directly onto the substrate, before being covered with resin. The resulting module does not require packaging: As both substrates are mutually compatible, the module can be directly connected to the motherboard substrate. This is not possible in the case of MCM (C) or MCM (D) modules, which make use of ceramic and silicon substrates, respectively (100 times more costly than FR4 on average). Because both materials are incompatible with the motherboard substrate, packaging that acts as an intermediary must be used.

Valtronic's solution makes it possible to skip one interconnection level (two instead of three, as the connection between packaging and motherboard is eliminated), increasing system reliability. It also saves space compared to packaged modules, thus making up somewhat for the loss in density due to the use of an FR4 instead of a more sophisticated substrate. Moreover, chip-on-board modules are generally thinner as the blobs of resin can be ground down to 0.1 mm above wire bonds; this is not possible with packaged modules. Lastly, Valtronic's solution is obviously quite economical thanks to cheaper materials, a smaller number of components to be assembled, and fewer manufacturing steps.

Good Compactness-Cost Ratio

Another space-saving method devised by Valtronic is "chip-on-chip" technology; that is, applying piggyback technology not to one chip or several chips placed side by side on a substrate, but to two chips, one being stacked on top of the other. The first chip acts as a silicon substrate for the second one, which is interconnected through wire bonds with the first chip as well as the first chip's substrate. This technology is especially useful where available space is three-dimensional or space around the chip is scarce. This solution, usually implemented on an FR4 substrate, provides a good compactness-to-cost ratio. This ratio can be made even better with a "flexirigid" substrate. This is the solution that was chosen for a hearing aid's electronics, for example: a stack of two chips and a set of SMCs [surface-mounted components] were deposited side by side on the printed circuit, which was then folded 180 degrees so that they faced each other.

France: Philips Produces 80-GHz MMIC Prototypes

93BR0400 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 28 Jan 93 p 22

[Article signed F.G.: "Microwave Integrated Circuits Reach 80 GHz"]

[Text] Philips Microwave Limeil (PML) is now able to make MMIC [monolithic microwave integrated circuits] prototypes operating at 80 GHz—a first in Europe and possibly worldwide.

As emphasized in the 14 January 1993 issue of ELECTRONIQUE INTERNATIONAL HEBDO, supply of standard and custom-made MMICs is currently expanding. Many French-based foundries are offering manufacturing services for circuits suited both for digital mobile communications (GSM [Global System for Mobile Communications] and DECT [Digital European Cordless Telephone], as well as Pointel and PCN [Personal Communications Network]), and for the future collision-avoidance radars for automobiles and wireless local area networks. In its Limeil-Brevannes factory (south east Paris), PML recently put into production a 0.2-micron grid length pseudomorphic HEMT [high electron mobility transistor] in gallium arsenide [GaAs] technology that makes it possible to create MMIC's operating at 80 GHz. Carrying reference D02AH, this technology includes features such as a 62-GHz current gain cut-off frequency, as well as a 0.9-dB noise level at 12 GHz with an 11-dB associated gain. PML also boasts a 0.5-micron grid length pseudomorphic HEMT technology for mass producing MMICs operating at a 37-GHz maximum frequency.

To our knowledge, PML is the only manufacturer currently offering pseudomorphic HEMT technologies. All others offer more conventional HEMT or FET [field-effect transistor] technologies. For example, Thomson-CSF Semiconducteurs Specifiques (TCS) is putting the finishing touch on a 0.25-micron HEMT technology called VLN02, which is geared toward production of very-low noise (1.4 dB at 18 GHz), wide-band (up to 40 GHz and more) MMICs. It has already spawned a power amplifier with a 5-dB noise level and a 12-dB gain at 55 GHz. As for Harris Semiconductor, this firm too has a 0.25-micron GaAs MMIC operating at 40 GHz.

On the other hand, while Europeans are still trying to define a frequency standard in this field, Harris Semiconductor, whose microwave components are marketed in France by Omega Technologies, has been preparing to market a range of standard, plastic-packaged MMICs that make it possible to build a complete receiver system (excluding modulating and demodulating filters) for a 2.4-GHz wireless communications system.

NUCLEAR R&D

CEA Launches Nuclear Fuel Test Loop

93WS0241C Paris AFP SCIENCES in French 21 Jan 93 p 17

[Unsigned article: "Launching of OMEGA-2 Test Loop for Improved Nuclear Fuel Performance"]

[Text] Grenoble—On 14 January at the Grenoble CEA Research Center, Yannick d'Escatha, CEA (Atomic Energy Commission) assistant general manager, inaugurated the OMEGA-2 test loop which makes it possible to test the thermohydraulic performance of fuel assemblies under conditions similar to those of a nuclear reactor.

The stakes are sizeable: a 1 percent gain in peak power means an additional annual production of 50 million kw/h, or a gain of 10 million French francs [Fr] for a 1000 megawatt plant...

The study and construction of OMEGA-2 has taken three years. This installation replaces OMEGA which was in use from 1975 to 1989 and became outdated. The new loop, which has actually been in operation since mid-1991 but could only be officially started this January, cost Fr35 million (with 35 percent funding from EDF and 65 percent from CEA).

With a power of 10 megawatts (1000 times that of an apartment), at a pressure of 150 bars (equivalent to the pressure encountered 1500 meters below sea level), and with peaks of 600°C, this loop simulates and analyzes the occurrence of what specialists call a "boil-over emergency," so as to prevent the real thing. This involves a sudden overheating which very rapidly increases the temperature of the fuel rod walls and can result in loss of the fuel shell seal. But according to EDF, such an incident has never occurred in French power stations.

"OMEGA-2 makes it possible to study the behavior of assemblies and to establish the conditions under which boil-over occurs, in order to be sure that the reactor is operated with an adequate safety margin," d'Escatha points out. This margin is very important and determines the peak power that can be drawn from a reactor core. "The most precise possible understanding of this phenomenon makes it possible to increase the lifetime of the fuel assembly, and especially to improve reactor performance," explained Luc Grosdaillon, head of the Thermohydraulic Laboratory.

Currently, the tests are conducted primarily for Framatome, for the development, export, or qualification of nuclear fuel for the French market. The fuel used by all French installations, whether produced by Framatome or by foreign suppliers like Siemens, is thus systematically tested on OMEGA-2.

An average of five to seven test runs are carried out annually. According to Grosdaillon, "each of them costs Fr2 million, with an additional million for the fuel assembly. The customer pays only two-thirds of this, unless he requests confidentiality, in which case he covers the total cost."

While there are other loops of this type in Japan, Germany, or the United States, OMEGA-2 together with its little sisters Graziella, Patricia, Deborah, Agate, and Hydromel (installations used for complementary tests on fuel assemblies), "remains one of the world's most effective testing tools in this field," d'Escatha pointed out.

UK Withdraws From Trilateral Fast Breeder Reactor Program

93MI0319 Bonn TECHNOLOGIE-NACHRICHTEN MANAGEMENT-INFORMATIONEN in German 15 Jan 93 pp 7-8

[Text] The British government has decided to withdraw from the joint European fast breeder reactor program on which the UK, France, and Germany agreed in 1984. This, said State Secretary Bernd Neumann of the BMFT [Federal Ministry of Research and Technology] in answer to a parliamentary question put by SPD [Social Democratic Party of Germany] deputy Wolf-Michael Catenhusen, was the outcome of the long-standing debate in the UK, with regard to which the federal government had kept in close contact over the past year with its British counterparts.

In 1984, the governments of the Federal Republic of Germany, the Kingdom of Belgium, the French Republic, the Italian Republic, and the United Kingdom of Great Britain and Northern Ireland concluded a treaty on cooperation regarding sodium-cooled breeding reactors. Pursuant to this treaty, German, French, and British research facilities and companies joined forces in 1989 to develop the European Fast Reactor [EFR]. The current stage, which marks a natural watershed, will conclude on schedule in March 1993, and the participants in the EFR project will decide before then on subsequent plans. The governments will examine how this will affect the governmental treaty in the light of the decision taken.

The BMFT ceased funding breeder technology in industry at the end of 1991, and until March 1993 the FRG will be fulfilling its contractual funding obligations vis-a-vis its European partners on the joint breeder project via the basic financing that it provides for the Karlsruhe Nuclear Research center (KfK).

The KfK's supervisory board asked the KfK on 24 November 1992 to drop its contributions to breeder technology in 1993 and to honor its international commitments only where absolutely essential. Indeed, as the relevance of breeder technology has diminished over the last few years, the KfK has already reduced its research work on this topic.

Moreover, [said Neumann] it was up to industry and the electricity companies to draw their own conclusions regarding the UK government's decision. The federal government respected this decision, which was a consequence of the current energy policy situation.

The current status of breeder development and its economic aspects gave no grounds for hope that breeder reactors would be able to generate electricity competitively with light water reactors in the foreseeable future.

SUPERCONDUCTIVITY

Germany: Development Trends Superconductivity-Based Technologies Summarized

93MI0287 Bonn BMFT JOURNAL in German Dec 92 p 10

[Excerpt] [Passage omitted] On the road to 21st-century technologies, ecologically and economically sophisticated developments are expected, especially as regards energy supplies. From electricity generation via transportation and conversion to storage and other aspects, superconductivity-based technologies will save raw materials, and improve efficiency, thus making for more intelligent energy use. A superconducting generator at helium temperature is already undergoing tests. Transformers, cables, and current limiters are currently being designed for the higher temperatures of liquid nitrogen. It will be 10 to 15 years, however, before they are in widespread use. Research work is concentrating on

scaling up the material properties found on a centimeter scale to kilometer proportions. Further potential applications are in raw materials separation, recycling, climate research, transportation, and health care. As soon as high-temperature superconductivity [HTSC] was discovered, the BMFT [Federal Ministry of Research and Technology] realized the importance of this technology. The funding program currently provides for project resources totaling approximately 320 million German marks [DM] for 1989 to 1995. Many institutions are participating in the work, which mainly takes the form of joint research.

When the position reached in German research work was established at a status seminar in Potsdam, it was found that fundamental problems of the new technology had been solved. The resonators and filters for high-frequency engineering that were presented, and the SQUIDs [superconducting quantum interface imaging devices] tested, achieved top international values.

The fact that these components had already been integrated into complete systems was especially encouraging. Staff from the Juelich Research Center demonstrated the high degree of sensitivity of HTSL SQUIDs in measuring human biomagnetic signals. Apart from signals emanating from cardiac activity, magnetic signals from brain activity were recorded with nitrogen-cooled SQUIDs—a world first. This is clear evidence of the potential of these materials in medical engineering.

TELECOMMUNICATIONS

Germany: Thyssen, Veba Obtain Marketing License for Digital Cellular Telephones

E-Plus Consortium

93MI0330A Bonn DIE WELT in German
8 Feb 93 p 14

[Text] The Duesseldorf E-Plus consortium, led by Thyssen and Veba, has been granted the operator's license for the new E1 digital mobile phone network, Federal Post and Telecommunications Minister Wolfgang Boetsch (CSU [Christian Social Union]) announced in Bonn yesterday. The competing consortium, led by the Bavarian firms BMW and MAN with their E-Star system, was unsuccessful with its bid.

The new minister was thus following the unanimous recommendation of an independent commission of experts, consisting of seven specialist committees. The commission had already recommended that his predecessor, Christian Schwarz-Schilling, award the license to the northwest German consortium at the end of November.

Boetsch stated that the 7.8 billion German marks [DM] being invested in developing the E1 network represented one of the decade's largest private investment projects. In light of the increasing decline in the economy, the project therefore had particular significance for the economy as a whole. E-Plus business would directly or indirectly create 8,000 new jobs, including 3,500 in the new laender, the minister pointed out.

The E1 network, development of which will begin this year, is expected to have around 3 million subscribers in Germany by the end of the decade. Market research already puts the level of demand at around 10 million mobile phone subscribers by the year 2000.

The members of the E-Plus consortium are Thyssen and Veba, each with a 28-percent holding, the American firm Bell South Enterprises with 21 percent, the British Vodafone Group with 16 percent, a French bank with 2 percent, and six partners from the new laender. Thyssen is represented through its Handelsunion division, while Veba has transferred its telecommunications business to Preussenelektra.

The head office of E-Plus Mobile Phones will, reportedly, be located in the Berlin/Potsdam area; a number of other cities, including Leipzig, Duesseldorf, and Hannover, will become regional centers.

The consortium plans to cater through its mobile phone network not only to such usual target groups as large companies, banks, and insurance companies, but also to the self-employed and private individuals.

The new E1 network is Germany's third digital, and second private, mobile phone network. Its competitors are the state-owned Telekom, with its D1, and the private Mannesmann Radio Phones, with D2. These two digital cellular mobile phone services registered their first subscribers in July last year.

C Network

93MI0330B Bonn DIE WELT in German
8 Feb 93 p 14

[Text] In 1985, Deutsche Bundespost presented what was then the most efficient mobile phone network in the world, its C Network. It can accommodate over 800,000 subscribers, with 630,000 currently using the service. It has over 1,100 base stations.

Demand continues to grow, as the analog equipment is perfectly adequate for those who require a mobile phone that operates anywhere in an extensive area. No wonder then that the 20,000-subscriber monthly growth rate has reached record levels.

To save customers having to choose between the C and D networks, dual telephones have been available for some time. Telekom intends the C Network to remain in operation at least until 2008.

D Network

93MI0330C Bonn DIE WELT in German 8 Feb 93 p 14

[Text] Last July's long-awaited launch of the two mobile phone networks created a completely new communications scenario. Following a 12-month delay, Telekom launched its D1 Network, Mannesmann's D2 starting a week later. Digitalization is the magic word, opening up a mass market with enormous revenue potential.

Insiders expect over 11 million subscribers across Europe by the end of 1995. They see the creation of the new GSM [Special Mobile Group] standard as spelling the end to the days of telephone nationalism; instead, they envisage a single mobile telephone system, without borders, stretching from the North Cape to Sicily. The telephones themsleves will be bug-proof, convenient, and give unprecedented reception quality. Another benefit is the constant fall in prices of telephone equipment and call charges.

E1 Network

93MI0330D Bonn DIE WELT in German 8 Feb 93 p 14

[Text] The E1 Network is another version of digital network operation in Europe. It operates at a very high frequency range (1.8 GHz) and its system structure makes it ideal for true mass communications. The network has a high subscriber density and also makes it possible to use miniature hand-held sets.

Unlike the digital D networks, where the large number of service providers offering a wide range of additional facilities makes the telephone industry a comprehensive service industry, the E1 network will be restricted to voice communication. An insider describes it as "a little telephone with few gimmicks and frills, that makes it possible to contact even pedestrians at all times, wherever they are." However, its success is likely to depend primarily on pricing.

Companies' Reactions

93MI0330E Bonn DIE WELT in German 8 Feb 93 p 14

[Text] "The decision obviously gives our company a great deal of pleasure," says Thyssen-Handelsunion chairman Dieter H. Vogel in Duesseldorf, welcoming the Thyssen/Veba E-Plus consortium's success. He feels the decision represents a triumph for competence, as E-Plus beat the rival Bavarian BMW/MAN consortium by nine to zero in the five qualifying criteria.

In Bogel's view, this left no scope for a political decision in favor of the Bavarians. Two years ago, when bids were considered for the D2 digital network, a western German consortium led by Mannesmann beat a southern German rival.

According to Vogel, Thyssen plans to invest around 4.6 billion German marks [DM] directly and an additional DM3.2 billion indirectly in the network, with half of these sums forthcoming by 1997. Around 8,000 new jobs will be created, including 3,500 in eastern Germany. E-Plus intends to have signed up a third of all mobile phone subscribers by the year 2000.

"We still believe our concept was the more realistic one," commented BMW, whose 20-percent stake makes it leader of the E-Star consortium, in Munich. BMW's Axicon subsidiary would continue its work in the mobile phone sector, although BMW's financial director, Volker Doppelfeld, had recently stated that the E1 Network [as published] would be the company's final venture into this area for the time being.

According to MAN (16-percent stake), the E-Star bid was based on "commercial viability and technical feasibility." MAN chairman Klaus Goette in particular had frequently claimed that the E-Plus group's stated intention of covering the whole of Germany by 1997 was "not technically feasible" and would require excessively high set-up costs. The unsuccessful consortium had tried to tip the balance by invoking the know-how of the American West Corporation (16-percent stake), which was currently setting up a similar network in Britain, but in vain.

EC Standardizes Wireless Local Area Network Technologies

93BR0380 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 21 Jan 93 p 15

[Article by Pierrick Arlot: "Europe Standardizes Wireless Local Area Networks"]

[Text] In the Old World, radiotransmitted local area network [LAN] data will be assigned the 2.4-GHz band. ETSI (European Telecommunications Standards Institute) is currently at work on the relevant standard, while French company Eurokip-TXcom is all set and ready to go.

Local area networks are witnessing a frantic race toward the least costly physical medium. Initially based on coaxial cabling, Ethernet very successfully switched to unshielded twisted pair [UTP] under the name 10Base-T. Even FDDI [fiber-distributed data interface] technology is now also eyeing twisted pair, even though it was originally developed for fiber optics. In such a context, it should come as no surprise that the current trend in LANs is the pure and simple elimination of the physical medium. The natural move then is for LANs to go wireless, because the very concept of wiring has drawbacks: Subsequent changes in the initial network architecture can double the start-up investment after five years.

Accordingly, technical projects for wireless LANs have mushroomed, at least on the other side of the Atlantic. Now Europe has begun to catch up and ETSI, the

competent standardizing body, is currently putting the finishing touch to a standard in this field. The chosen frequency band is that of 2.4 GHz.

NCR and Motorola Lead the Pack

The first radio wave wireless LANs were born in late 1990[1]. Among the pioneers were NCR, with its WaveLAN—a 2-Mbit/s LAN using a radio wave in the 902-928-MHz band—and Motorola, with the Altair microwave (18-GHz) system. Since then, many new, specialized companies have opened in North America (Windata, Solectek, Proxim, etc.), taking advantage of the 902-928-MHz, 2.4-2.485-GHz, and 5.7-5.825-GHz bands, three frequency bands for which the use of "large spectrum" radio waves is less regulated in the United States than those of "narrow band" radio waves[2].

In France, regulation pertaining to wireless LANs is particularly constricting. Obviously, devices using a band around 900 MHz have no chance of finding a market in France, as this frequency range is reserved to GSM [Global System for Mobile Communications].... Consequently, the DGR has prohibited NCR from marketing its wireless products in France. Today, only those systems that comply with standard 1542, set out in August 1990 by the CNET [National Center for Telecommunications Research], may be sold. Standard 1542 authorizes use of the 225-MHz band (six 200-kHz-wide channels between 223.7-MHz and 224.9-MHz) with discretion, if power does not exceed 5 mW, or subject to a DRG license up to 100 mW. This standard results from an adaptation to data transmission, due to an initiative by French company Eurokip-TXcom, of an existing standard that was limited to remote control or telemetry applications.

Eurokip-TXcom, a France Telecom affiliate, created the Radiolink wireless LAN in 1991; terminals can be as distant as 200 meters from one another in an open space and communicate at a rate of 38 Kbits/s. Since then, standard 1542 has spawned many applications in industrial radiocommunications. Eurokip-TXcom works from client specifications and supplies custom-made radio modules or packs. It developed a radio module complying with standard 1542 for Telxon, a portable terminals manufacturer, and is working with NCR to adapt standard-1542-compatible modules to the computer manufacturer's keyboardless machines... Eurokip-TXcom also works with EDF [French Electricity Company] on a remote meter-reading project and has developed radiocommunications systems for the April robots. However, Eurokip-TXcom has its sight set on a more ambitious objective: the European LAN Data Radiotransmission Standard, which is currently being elaborated.

An ETSI committee was asked to submit a technical proposal before March 1993. Certainly, the standard will associate the 2.4-GHz band and a spectrum-spread and frequency-hopping technology. However, the slow pace of the administrative process pertaining to the development of a European standard (public surveys, definition of a European-wide terminal authorization process) will probably delay the standard's implementation until late 1994...if everything goes right. "In its final version, the standard is not likely to be implemented before late 1995," says Eurokip-TXcom senior executive Bernard Malaise. "As for the Americans, they are ready. For example, Telxon has just bought out Telesystems, a company that specializes in radio modules for LANs. We must make sure we are not left behind," he adds.

Eurokip-TXcom has already refined a prototype 2.4-GHz radio module, the industrial version of which could be operational before year's end. The company is hoping the DRG will grant it a dispensation, so it can market its product before standardizing bodies come up with their final version of the standard. In addition, Eurokip-TXcom is busy upgrading some of its radio modules to PCMCIA format, as the popularization of portable computers with standard-mounted PCMCIA connectors could open a very lucrative market for such products. American company Proxim has taken the approach one step further and convinced Bull subsidiary Zenith Data Systems to follow its example.

Footnotes

1. Other companies, such as BICC and Photonics, offer LANs based on infrared-link technology.

2. Spread-spectrum technology distributes broadcast energy on a frequency band much wider than is the case with narrow-band transmission (several tens of MHz as compared to a few kHz). This provides better security against outside interference. Spectrum spread can be achieved globally (energy is distributed more or less evenly over the range of available frequencies) or through the frequency hopping technique (the waveband is divided into several tens of channels and the signal "hops" channels several times per second). This technique offers the best security against outside disruptions. It is used by, among others, the military in their PR4G (fourth-generation radio), which has 2,320 25-kHz channels in the 30-88-MHz band.

Philips Makes Further HDTV Development Contingent on EC Subsidies

93BR0394 Antwerp DE FINANCIEEL-EKONOMISCHE TIJD in Dutch 2 Feb 93 p 9

[Article signed W.V.D.V.: "Philips Puts HDTV Future in the Hands of the EC—Twenty Billion Belgian Francs in Subsidies Needed"]

[Excerpts] Philips is putting its project for high-definition television (HDTV) on the back burner. If the EC does not grant a subsidy of ECU500 million (20 billion Belgian francs [BFr]), then Philips feels that it does not make sense to manufacture HDTV equipment

based on MAC standards. The HDTV system is technically ready, but the practical applications will not see daylight for some time.

Since 1986, Philips has invested some 350 to 400 million Dutch guilders in the HDTV project. However, in an exclusive interview with FINANCIEEL DAGBLAD, President Bodt of Philips Consumer Electronics let it be known that investments will be reduced by tens of millions of guilders—and put into other projects—if the EC no longer wishes to subsidize HDTV. "It does not make sense to start up an HDTV-MAC product line if there are no programs," says Bodt.

This decision will not have a "major" impact on the results of the consumer electronics division, which is said to have made a loss of around 800 million guilders in 1992. Philips would like to offset the malaise in the consumer electronics market by reducing production at its Hasselt site, among others. Layoffs have not been ruled out. [passage omitted]

"With the 650-million-guilder subsidy from the EUREKA program, the industry has been able to get HDTV technically off the ground in Europe," says Bodt.

However, the practical switch-over to HDTV presents bigger problems. The cable, as well as the recording, transmitting, and receiving equipment, will have to be completely changed for HDTV.

This revolution represents enormous growth potential for the entire audiovisual sector. According to some forecasts, new system products represent a worldwide market of some BFr1,250 billion, but who is going to take the plunge and invest?

According to Philips's public relations spokesman Elbers, HDTV can get off to a good start if the EC puts the earmarked BFr20 billion on the table to encourage the production of programs. "This is the shove that will get the HDTV train moving. The industry is ready for it," says Elbers. A recent KPMG [Klynveld Peat Marwick Goerdeler] study shows that without this subsidy the European electronics industry will not sell more than BFr100 billion worth of wide-screen HDTV equipment by the year 2000. However, if a subsidy is granted, the amount sold will more likely be in the neighborhood of BFr1,000 billion.

America

The EC, and especially the United Kingdom, have some reservations. In fact, the United States has been working for two years on a digital version of HDTV. "For a long time, the Americans left the development of HDTV hardware up to Japan and Europe so that they could concentrate on software. They decided to jump on board too, so that they would not lose their grip on microhardware for computers," says Mrs. De Bens, professor of communications sciences at the University of Ghent. "As a result, the Japanese and European analog systems seem already obsolescent before they are even on the market."

Philips President Bodt feels that this is a nonsensical argument and says that a digital HDTV system could be launched immediately. "But this does not change the problem at all."

"The question remains as to who is going to pay for the investments in digital recording equipment." If, in May, the EC decides to grant subsidies, Philips feels that it is feasible to start HD-MAC by the end of 1994, provided there are enough programs.

Professor De Bens remarked that HDTV will require further serious investment. Thus, its introduction will require the installation of new cables. She is especially concerned about the cost price of the new HDTV end-user equipment, which must be compatible with both the traditional and MAC standards. In Japan, an HDTV set currently costs BFr700,000. Broadcasters are also facing major investments. "They have to buy new recording and transmitting equipment and, at the same time, lease an extremely expensive satellite-based broadcast channel. In the beginning, HDTV will certainly be a prestige project, for which public broadcasters will have to bear the costs. From the profit point of view, private broadcasters still view HDTV as too risky.

SCIENCE & TECHNOLOGY POLICY

Future of Macedonian Science Viewed

93WS0265A Skopje VECER in Macedonian
30-31 Jan 93 pp 10-11

[Interview with Academician Dr. Georgi Efremov on the status of scientific institutions and the university, by Zlate Lozanovski; place and date not given: "The Power of Political Subjects"]

[Text] *The resistance came and is still coming from the "powers that be," and from positions reached not on the basis of knowledge and worth but as a result of service to the political nomenclature.*

Academician Dr. Georgi Efremov joined the ranks of the most radical and most attractive ministers of the transitional government by the specific steps he took, as well as his ideas for which, however, not much time for their implementation remained (18 months). The value of his activities, as the first minister of science, at the time opposed by some institutions and individuals, has now been truly recognized and, although silently, his work is earning increasing approval.

Perhaps not everything he earmarked will be implemented. It is certain, however, that whatever is accomplished will leave profound traces in the work of the Ministry of Science and the university.... If nothing else, at least all subsequent activities of these institutions will be added to those implemented by the present ex-minister.

[Lozanovski] Mr. Efremov, as the first minister of science in the now former government, you became maximally committed to the implementation of a new concept and vision concerning the organizational and legal structuring of existing scientific institutions. The changes you suggested triggered major opposition by some of the institutions. Was this opposition caused by the fact that it was precisely you who had suggested these changes, or else do you believe that these scientists were not prepared to accept something different from the durable pattern they followed in their "work"?

[Efremov] I insisted on having a real reform in the university and in the work of independent scientists, whose inefficiency was partially the result of an incompetent leading cadre. The changes which I suggested were consistent with a contemporary interpretation of science and higher education and also set contemporary standards and criteria in the choice of teaching and scientific personnel. The resistance came from a small number of university instructors and scientific workers, including one member of the MANU [Macedonian Academy of Arts and Sciences] who had acquired their "reputation" not as a result of their pedagogical, scientific, or expert knowledge but by performing functions in the previous sociopolitical associations, public councils, SIZ [Self-Governing Community of Interests], trade union, or leading functions in the then SKM [League of Communists of Macedonia], who were members of the executive authorities of their department, institution, or university. Opposition came and is still coming from the "powers that be" who have survived not because of real qualities and knowledge but on the basis of positions acquired in the form of privileges granted by the social structure and service to the then political nomenclature. The honest and active creative workers were either ignored or attacked by incapable, weak, and noncreative cadres who intuitively joined forces. Obedience was exceptionally valued, while knowledge and disobedience were penalized. It was such a university stratum that created a circle within which the creativity of the young generation was crushed. Its mentality was to review its own accomplishments for the sake of its own advancement and for acquiring teaching and scientific titles, and thus becoming member of the tight circle of a scientific unit, the core of which was to tolerate loss of quality. Reviews were being written by one's closest colleagues in universities and autonomous scientific institutions for promotion to a higher position. Sometimes a review was written even by the candidate himself, and his friends would sign it. Some departments and institutions included in their projects well-known names of people who, in general, did not participate in the work on that project. There was and still is extreme lack of objectivity in presenting national awards to scientific workers. Mediocre members of committees and commissions were elected, who rejected any quality accomplishments and rewarded the incapable.

Resistance and Legitimacy

[Efremov] It is worth pointing out that, with few exceptions, the opposition comes from several professors of the School of Law. Some of them have gone so far as to question my legitimacy and the legitimacy of the former government (NOVA MAKEDONIJA, 14 December 1991, and PULS, 12 December 1991). I shall not undertake to defend my legitimacy, but as to their own legitimacy I suggest to those interested to read a review on their choices for the title of full professor. I also suggest to interested readers to read the interview of the present rector, Professor Cokrevski, published in LIK-NOVA MAKEDONIJA (23 December 1992) in which he says, among others, that "I profoundly believe in the need and necessity of change in the university but not in the type of radical steps which would cause trouble among the university public," or the assessment of our university when he says that "the university has a stable developed scientific and educational structure that, with few exceptions (I believe the opposite to be true) is on the level of European and global criteria in the fields of science and education."

Are such views accurate and do they promote the advancement of our university and our science? Has the time not come to put an end to praises and to point out weaknesses and shortcomings? The active university cadre is not afraid of radical changes. However, the university cadre satisfied exclusively with the formal

aspect of the law would oppose such changes. The activeness of the university cadre is assessed on the basis of the results of its pedagogical, scientific, and professional activities.

[Lozanovski] How is the contribution of a university and scientific worker assessed?

[Efremov] Without elaborating on the pedagogical activities of our university cadres, the scientific contribution of the university worker is assessed on the basis of the number and quality of his works published in scientific journals, whereas his scientific contribution is judged on the basis of the adopted technical and technological solutions in the economy. The scientific recognition of our university cadre throughout the world is such that only 10 percent of them are listed in the international rostrums of scientific workers, and only 3 percent of their scientific works are mentioned in foreign scientific publications. It is of interest to note that, with minimal exceptions, university instructors who established their reputation by performing functions in sociopolitical organizations or praising the executive powers and those with "legitimacy" are in general not considered scientific workers; their scientific contribution is equal to zero, whereas anonymous scientific workers among us, naturally, are the people whose works are being quoted and who have contributed to the international recognition of our science and state. Are such facts not sufficient to justify a real reform of the university or the introduction of modern standards and criteria that would affect the legitimacy of university officials? What are the effects of the professional work of the university cadre when, with minimal exceptions, no acceptable technical and technological solutions have been demanded by our economy and when soon our industry will be based on imported technology, without exception? Should I quote further arguments in support of the need for real reform in the university and the scientific institutions or is it necessary for our people, in the future as well, to pay a price for ignorance, for lack of knowledge of the condition in its own university, and for ignorance of the standards which must be maintained by a modern university?

No Application

[Lozanovski] Could the law, as an administrative instrument, be able to, and to what extent could it influence changes in the way of thinking and approaches to the work, something that, under different circumstances, would be valued?

[Efremov] As anywhere else, in science the law regulates relations between the state and its subjects. In the case of the Law on Scientific Research, it also resolves the issue of individuals engaged in scientific research and can influence the way of thinking, mentality, and approach to the work of scientific workers through the regulations governing their selection. The still applicable Law on Scientific Research has relatively good criteria for awarding a scientific degree but only from the formal rather than the factual side of the matter. For example, the title of scientific associate or docent requires of the candidate to have a doctorate in the scientific field for which he will be chosen, published scientific works, and accomplishments in the application of scientific research results. To the best of my knowledge, over the past 10 years no change has been made in such criteria. All the selected scientific associates or docents have officially met the required prerequisites. However, if we were to rate the value of a doctorate we would note that, with minimal exceptions, no scientific contribution has been made. The candidate who has earned the title of doctor of sciences has not developed as an independent scientific worker; his scientific works (actually professional works) are published in scientifically worthless periodicals, or else included in anthologies of scientific (actually professional) household compilations (in fact advice), while the results of his scientific research have not found any application whatsoever in the economy. This is confirmed by the fact that an exceptionally small number of defended doctorates in our country have been acknowledged in global scientific publications or have found a practical application. Specifically, since the founding of the university in Skopje, to this day doctoral degrees have been granted to more than 1,000 highly trained cadres. If only 10 percent of the doctoral theses had made a contribution to science, our science would have been highly noted in global science, and our economy would have had its own technical and technological solutions rather than rely on imported technologies.

The new Law on Scientific Research, which was drafted by the Ministry of Science under my tenure introduced stricter criteria compared to those in the present law. Unfortunately, the new law is still about to be submitted, for the bearers of various functions in the university and the "powers that be" are preventing its submission, although this was the first law submitted by the former government to the Assembly as early as June 1991. What kind of efficiency is the university showing concerning its executive bodies?

Anonymous Review

[Lozanovski] A high percentage of our scientists immediately interpret any criticism of a work as an attack on the institution, on the national interests, etc. Why is it so difficult to "separate" the scientific individual from the scientific institution?

[Efremov] The introduction of an anonymous review of the annual and final results of scientific research projects financed by the Ministry of Science and anonymous reviews of new draft plans submitted to the Ministry of Science were a new development for our scientific workers and it was natural that some of them would rebel against it. I may point out that such rebellion came from the quasi-scientific workers, for an anonymous review is the same as a correction of eventual shortcomings of the research team working on current projects, or of eventual shortcomings in a draft project. At the same time, it provides a guarantee to the financier, in this case the

state, that the project will be successfully completed. An anonymous review is not an "attack" against an author or an institution, or else any harm caused to the national interest. It is not my invention but simply the application of a generally acceptable criterion. Suffice it to say that the projects submitted by NASA are subject to anonymous review.

[Lozanovski] To what extent are you personally satisfied with what you were able to accomplish for the scientific institutions, the young scientists, and the implementation of various projects, as minister of science?

[Efremov] I am much more satisfied than I expected to be during the time I worked as minister of science. Let me mention some of the achievements of the Ministry of Science. In less than 18 months, the Ministry of Science created an atmosphere for the right treatment of science. The first government of the Republic of Macedonia showed an overall understanding of the efforts of the Ministry of Science to create better conditions for the work of scientific workers but also for making them more responsible. Hence the funds for science which, in the first half of 1991, when the government was formed, amounted to 0.5 percent of the Republic's budget, following the rebalancing of the budget were doubled and, in the 1992 budget, were tripled. After 40 to 45 years, the institutes dealing with the national disciplines and, subsequently, the other independent institutes, were reorganized as direct beneficiaries of the Republic's budget. After 25 years of existence, the Macedonian Academy of Arts and Sciences was granted funds from the Republic's budget to perform its own function of becoming a fund for science. The Ministry of Science drafted the first new law and not a "law on amending and supplementing of the law...," and submitted it to the Assembly as early as July 1991, a law that, as I already pointed out, was blocked by the "powers that be." The Ministry of Science appropriated stimulating funds for the procurement of scientific research equipment. It broadened the program for the development of young scientists and ensured the individual income of postgraduates working on scientific research projects. It voided the resolution on reimbursements of personal income (honorariums) to university workers working on projects financed by the Ministry of Science; it introduced an anonymous review of draft projects and annual work results; it set up a record book of scientific research cadres and undertook the evaluation of the international recognition of our scientific cadres.

The Ministry of Science was the first ministry, the first institution in the Republic that, as early as last April, turned to the international scientific public with a demand for the international recognition of our state. The Ministry of Science drafted a publication in English entitled "*Science in Macedonia*" which is the first and only publication of its kind in our country to meet with an exceptionally warm acceptance. To conclude, in answer to your question, I would be more than satisfied if the initiatives which I started would be pursued in the future.

AEROSPACE

Brazil: Russians To Develop Fuel for Launch Vehicle

93SM0135X Sao Paulo GAZETA MERCANTIL in Portuguese 23-25 Jan 93 p 5

[Article by Brasilia correspondent Luiza Pastor]

[Text] Pernambuco State PMDB [Brazilian Democratic Movement Party] Senator Mansueto de Lavor, rapporteur for the Joint Congressional Budget Committee, has decided to reconsider the appropriation he had earmarked for the Brazilian space program, in which only 16 billion cruzeiros of the 70 billion cruzeiros requested by the Brazilian Aerospace Commission (COBAE) were allocated for the development of the Satellite Launch Vehicle (VLS).

Mansueto de Lavor expressed his irritation with the repeated changes in the launch date of the SCD-1 and assured GAZETA MERCANTIL that he intends to reexamine the appropriations for research and development to see how much is still possible to allocate to the Brazilian rocket project, as well as for the development of the Alcantara Launch Center (CLA) in Maranhao State. That base, which is advantageously located from the standpoint of international competition, would, if completed, enable Brazil to be included in the exclusive club of countries that compete in the satellite launch market.

Additional information that predisposes the senator to release more funds for the mission is that a group of 12 Russian scientists contacted [as published] by the Aerospace Technical Center (CTA) is already in Brazil, having been invited to work on the project to develop fuel for the three stages of the launch vehicle. The presence of those scientists was confirmed to GAZETA MERCANTIL this week by Colonel Freitas Bastos, executive director of COBAE, who cautioned that the contracting of the Russians was "still extra-official" since it has not been submitted to the plenary of the Committee for ratification.

"We cannot have these brains here in Brazil without a function that enables them to be well utilized," Mansueto de Lavor emphasized. However, the latest partial figures from his report show that 67 percent of the Union budget funds will go to pay off the public debt, and only 1.4 percent is to be spent under the heading of projects and development of the country in general. Under the item for science and technology, which covers not only the ministry but all the research fields in the various areas of the Executive Branch, the total budget forecast by Mansueto de Lavor is 2.37 trillion cruzeiros—of which the Ministry of Science and Technology itself will get only $1.78 trillion cruzeiros, in April 1992 values. Those sums, the budget committee advisers explain, will have to be updated by multiplying them by a factor yet to be determined, but that will be somewhere between 15 and 20.

Regarding the space mission, the VLS has 16.2 billion cruzeiros available so far, and the program to develop the SCD-2, the satellite that will be the successor to the SCD-1, is getting 1.8 billion cruzeiros; the installation of the base at Alcantara, in turn, received an appropriation of 8.8 billion cruzeiros.

The situation is not very different in other areas of high-tech research. According to the senator, the budget sought by the Navy Ministry, for example, called for only 2.3 billion cruzeiros under the heading of research and development, with the specific program for the Antarctic not being separately listed. In his final version of the report, he obligated 1.9 billion cruzeiros to the research being done in that region.

ENERGY, ENVIRONMENT

Brazil: Digicon Manufactures Solar Panels for SCD-2 Satellite

93SM0135Y Sao Paulo GAZETA MERCANTIL in Portuguese 27 Jan 93 p 12

[Article by Porto Alegre correspondent Lilian Bem David]

[Text] On 27 February, Digicon S.A., of Gravatai, Rio Grande do Sul State, will deliver the eight solar panels that will generate all the energy used by the equipment on board the second Brazilian data collection satellite, known as SCD-2 and to be launched this December from Kennedy Space Center in Cape Canaveral, Florida, by the National Institute of Space Research (INPE). The panels for the first satellite, to be launched in February, were imported ready-made from the German firm Messerschmitt Bolkow Blohm GmbH (MBB).

Digicon invested $500,000 of its own funds in the project and will receive $370,000 from INPE by the time the panels are delivered, said the company's special projects manager, Jose Carlos Araujo. "Digicon is gaining a permanent infrastructure that will be used to make other solar panels," Araujo said. "For satellites similar to the SCD-2, the cost of making the panels will drop by 30 percent."

Each measuring 760 mm tall by 400 mm wide, the eight panels form an octahedron that will convert sunlight to electrical energy. It is the foundation for 1,016 silicon cells (127 per panel) whose job it is to capture the sun's rays. The layout can generate 70 watts an hour, enough to power the radio telemetry system and other equipment housed in the satellite.

Sunlight

Light is captured during the approximately 50 minutes, out of the 100 minutes that it takes the SCD-2 to complete one trip around the earth in an orbit 700 km away from the planet, when the sun is not hidden. The charged batteries supply the rest. The satellite will be assigned to make sweeps of Brazil's entire territory,

collecting environmental data such as rainfall, air and water temperatures, atmospheric pressure, and the tides. The data, scattered on platforms at various points in Brazil, will be transmitted to the central station in Cuiaba (Mato Grosso State).

"The payload of these first satellites is not as important as our observation of their interaction with the earth. Brazilians will be able to learn to correct the movements of one of their own vehicles in space," Araujo noted. To Digicon, which ranks eighth in Brazil in industrial automation according to the magazine BALANCO ANUAL, and started the solar panels project in 1988 after going through a rigorous INPE selection process, this effort meant inclusion in a select group of fewer than 20 companies worldwide that make solar generators for use in space.

Complex Project

The silicon cells were imported from the U.S. firm Spectrolab. Araujo explained that these are extremely delicate components, 2.5 cm wide, 6 cm long, and only 0.2 mm thick. "We had to glue glass over each cell, the same size and thickness, to protect them from micrometeorites," he said. The glass cannot be at all opaque, otherwise there would be a loss of ability to capture light, and the resin in the adhesive must not form bubbles that would swell and explode the panels once they leave the earth's atmosphere. Digicon decided to import the resin from another U.S. firm, Dow Corning.

"The cells, doped with boron, were glued and connected in series to form the modules that permit conversion of light into electric current," Araujo explained. The cells contain filaments of silver, five microns thick, that form the energy collector tube. The cells are welded to the panel with silver connectors, 12 microns thick. The project required perfecting of more than 40 processes and the manufacture of a prototype before the final panels could be made. Testing was done at INPE's Tests and Integration Laboratory in Sao Jose dos Campos, Sao Paulo State, with the assistance of MBB, the firm that made the panels for the first satellite.

Digicon plans to move deliberately in entering this new market that Araujo terms very promising. "Space projects require the establishment of mutual trust among companies and governments so that the technology is not lost," he said.

Last year, Digicon had sales of $7.6 million from products such as digital position indicators, graphic peripherals, programmable controllers, and traffic control devices.

[Box p 6, text by Brasilia correspondent Luiza Pastor]

New Launch Date

The launch of the SCD-1 data collection satellite has once again been postponed, this time because of a defect found by the U.S. firm responsible for the operation, Orbital Science Corporation (OSC), in the computer on board the Pegasus rocket. The new date likely to be scheduled by the company for the SCD-1's entry into orbit will be between 5 and 15 February, when the window that enables the vehicle to enter the right orbit will be open again.

This is the fourth postponement of the launch of the SCD-1 since OSC was contracted by the Brazilian government. Initially scheduled for the end of last year, the operation had been officially confirmed for 7 January and then rescheduled for the 9th, because poor weather in the area had prevented the B-52 aircraft that takes off with the Pegasus under its wings from arriving at Kennedy Space Center in Florida.

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